The influence of visual emotional input properties on the acquisition of verb meanings in 24-month-old German learning children

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Abstract

Previous research shows that emotional properties of the input (extrinsic properties) enhance children's learning of novel words. These properties are not features of the referent a novel word is referring to, e.g. the +/-happy intonation or facial expression of a speaker, who is referring to an object or event by using a novel word. With respect to this finding, the present study focuses on two unnoticed questions: a) Are similar influences found when the emotional properties are features of the referent of the word to be acquired (intrinsic properties), e.g. the +/-happy facial expression of an actor in an event that is labeled by a novel verb? b) Do these properties influence the meaning of a novel word, in that the emotional information constrains how the word is interpreted in later contexts? The results indicate that in line with studies on extrinsic emotional properties children's learning of novel words is enhanced by intrinsic emotional properties. Furthermore, the study suggests that children's perception of emotional information while learning a novel word is subject to individual variability, which affects how children construct and interpret the meaning of the novel word. Different factors such as language competence, attentional control and social cognition are discussed for inducing individual differences in emotion perception while word learning.

Contents

Introduction

Learning the meaning of a novel word, whether spoken, signed, or written, entails the task of identifying the things or concepts[1] it is referring to. As soon as children recognize words in the speech stream based on prosodic information (Jusczyk & Aslin, 1995), they also combine first words, e.g. *mommy* or *daddy*, with meaning by demonstrating that they match the auditory information 'mommy' and 'daddy' with a presented video image of their mother and father respectively (Tincoff & Jusczyk, 1999). That is, they must have a mental concept of their mother or father which they can map to the presented auditory information. However, how children master the form-meaning mapping and which aspects, e.g. perceptual, social, linguistic information, in the learning environment play a role in their word meaning formation is yet only partially understood.

The current study aims to contribute to the question of how children's perception of visual emotional information in a word learning situation influences their learning and memory of novel word meanings. The role of emotional input information for early word learning has only been marginally considered in previous research. However, there is an increasing amount of evidence suggesting that the detection, processing, and memory of verbal (words, stories) and non-verbal (pictures) stimuli in older children and adults can be enhanced by emotional information (e.g. Davidson, Luo, & Burden, 2001; Kensinger & Corkin, 2003; Kousta, Vinson, & Vigliocco, 2009; LoBue, 2009; Öhman, Flykt, & Esteves, 2001).

Based on the question of how the emotional information is presented to children in a word learning situation, two main types of emotional input information can be defined:

a) **extrinsic** emotional properties: properties which are not properties of the referents of the words to be learned, e.g. the +/- friendly face of a speaker who is referring to an object or action/event.
b) **intrinsic** emotional properties: properties displayed by the referents the word is referring to, e.g. +/- pleasant features of an object (e.g. fur vs. spikes), the +/- friendly facial

[1] By using the term *concept*, I refer to mental representations which describe internal mental states and processes like perceptions, memories, propositional attitudes etc.

expression of the actor of an action (e.g. *angry facial expression*), or +/- pleasant properties of an action itself (e.g. *caressing* vs. *beating*).

So far studies investigating the role of emotional input information in early childhood have focused on the influence of extrinsic emotional properties. A small number of these studies have asked whether extrinsic acoustically presented cues enhance the word learning process (see Chapter 3). However, the majority of studies investigated infants' ability to interpret emotional cues according to an adult's communicative intention (termed *social referencing*). This ability is argued to be a prerequisite for the understanding of the function of words in joint interactions (Bloom, 2000). In these studies, for example, an adult refers to an object while displaying a happy emotional facial expression to arouse the child's interest for an object they jointly pay attention to (e.g. Moses, Baldwin, Rosicky, & Tidball, 2001). A behavior of the child that corresponds to the emotion expression (e.g. to approach the object referred to) is thought to reflect the child's ability to adequately interpret the adult's intention.

In contrast to these studies, the current study addresses the influence of intrinsic emotional input properties on word learning by exploring two questions: (a) Do intrinsic emotional input properties – like extrinsic ones – affect the mapping (i.e., attention, encoding) and memory (i.e., retrieval) process of novel words? and (b) Does intrinsic emotional input information influence the content of a word that is learned, i.e., the word's meaning? With respect to the latter, it is specifically asked whether the emotional context information a child perceives in a word learning situation affects the formation of the word's mental concept. To this end, imagine the following example: two learners, A and B, watch an action (e.g. waving) which differs only in the facial expression of the actor who is presenting the action, e.g. friendly vs. unfriendly. Simultaneously, they are listening to a sentence containing a novel verb (*telping*), e.g. 'X is *telping* the balloon'. Will they construct different meanings for this novel verb? This question depends on whether children perceive and recognize the different emotional valence of the actor's facial expression and interpret it as an expression of a positive (e.g. pleasure) and negative (e.g. anger) internal psychological state respectively. In the latter case, their interpretation may result in a word meaning like *negative* (e.g. threatening, punitive) *waving* for the novel verb (telping).

In contrast to social referencing studies using extrinsic cues in child-adult interactions, the intrinsic emotional cue is not instantiated by an adult in order to assist the child in interpreting an ambiguous situation. Rather, the child alone has to recognize the emotional input information in the word learning situation and consider it as relevant for word meaning formation (Bloom, Tinker, & Kofsky Scholnick, 2001). This process strongly depends on children's evolving attention regulation, social cognition[2], and linguistic competence. Thus, the investigation of the role of intrinsic emotional input properties in word meaning acquisition provides the opportunity to systematically investigate the interaction of these capacities in early development.

In the present study, the interaction was investigated by presenting 24-month-old children with intrinsic emotional input properties while they were learning and remembering novel verb meanings.

Reader's guide

In the following theoretical section, the empirical evidence based on which the hypotheses of the present study are formulated is presented. Chapter 1 discusses which problems children have to master in learning novel verb meanings and which information they use in dealing with this task. In Chapter 2, empirical results are presented suggesting that children can perceive and recognize emotional information early on. Nevertheless, there are very few studies dedicated to the question of how children's perception of emotional information affects their learning of novel words. The results of these studies are presented in Chapter 3, with the remark that solely the influence of extrinsic emotional input properties on word learning was investigated. Chapter 4 focusses on the role of emotional information in non-verbal communication and its function for the understanding

[2] By using the term *social cognition* (Meltzoff (2010), I refer to children's growing ability to reason about other people's behavior in terms of their emotional and mental states (i.e., intentions, beliefs, desires). Thus, social cognition, as it is used here, encompasses children's developing *Theory of Mind* and *Empathy* capacities. *Theory of Mind* refers explicitly to the ability to ascribe mental states to other people (Frith and Frith (2005), while *Empathy* can be defined as the ability to feel (emotional contagion) and understand (empathic perspective taking) others' emotions (McDonald and Messinger (2011).

of others' intentions, which is a prerequisite for word learning. After summarizing the evidence and formulating the hypotheses (Chapter 5), the experimental method applied in the present study is described (Chapter 6). In the subsequent two chapters (Chapter 7 and 8), the experimental design and empirical results of two studies are presented. Chapter 7 describes a study that investigated whether intrinsic emotional input properties affect children's verb learning and memory processes. In Chapter 8, a second study which examined whether intrinsic emotional properties affect children's verb meaning formation is outlined. In each of these chapters the results are discussed individually and revisited in the general discussion of Chapter 9. Here, the findings of both studies are reasoned with respect to results of previous research, while importance is given to various suggestions for further investigations into the topic of how intrinsic emotional input properties affect the acquisition of word meanings.

Theoretical and empirical background

1 What children have to acquire when learning verbs

Verbs refer to actions (e.g. run, sleep, wither) and relations between entities (e.g. John loves Mary). Learning a verb presents children with the task of acquiring the information an adult speaker requires to correctly process a verb phonologically, grammatically and semantically. In the following example, it is illustrated in a simplified form, which information an adult is thought to possess to comprehend and use the verb *carry* correctly:

(1) /carry/; VERB; < x (y) > [x CAUSE [MOVE y]]

The term /carry/ represents the phonological information. VERB constitutes the syntactic category. The term x(y) specifies the verb's argument structure, and [x CAUSE…] represents the grammatically relevant semantic information of the verb, which corresponds to what is varyingly called *Semantic Form* (SF, Bierwisch, 1986, 2007; Wunderlich, 1997) or *Lexical Conceptual Structure* (LCS, Levin & Rappaport Hovav, 1995). The verb's semantic information represents the thematic relations that the verb allocates via the argument structure to those constituents that syntactically realize the verb's arguments. Each argument position relates to one thematic role. The verb *carry* allocates two thematic roles: AGENS and PATIENS. The thematic attribution of AGENS and PATIENS is served by the SF/LCS of the verb such that AGENS is determined by the term CAUSE and the variable x and PATIENS by [MOVE y] embedded in CAUSE. Thus, each syntactic position is assigned to one thematic role if the argument position is linked to a variable in the verb's SF/LCS: In a sentence like *The girl is carrying the bag* the semantic information of *carry* specifies the relation between two arguments, the girl (AGENS) and the bag (PATIENS), which are syntactically realized as subject (AGENS) and object (PATIENS). In sum, this example indicates that learning a verb presents children with a number of phonological, semantical, and syntactical sub-problems. In particular, the verb learning task involves children being able to identify, categorize, and map the relevant linguistic unit (e.g. verb) to the corresponding perceptual unit (e.g. action) of an event. For example, hearing a sentence like ‘The man *is telping* the balloon!’, while watching a man waving a balloon requires learners, on the one hand, to segment the relevant novel word ‘telping’ from the speech stream and categorize this form as verb. On the other hand, they have to identify the action (waving) and the event participants representing the verb’s arguments (man, balloon) and map the outcome of this analysis onto the linguistic form resulting in the transitive verb *telping* (Waxman & Lidz, 2006).

For the current study, it is assumed that 24-month-old children master these sub-problems in learning novel verbs while it is asked how visual emotional input information affects this learning process. In the following section, empirical results are presented, which provide evidence for verb learning proficiency in this age group.

1.1 Verb meaning acquisition

Concerning the question of how children accomplish the task of identifying the referent of a novel verb in a complex learning event, research revealed that in addition to visual observation, children use syntactic information to constrain their hypotheses (Gleitman, 1990). In particular, it was shown in various experiments across different languages (Japanese, English) that children use the sentence structure (e.g. the number and relation of argument noun phrases [NP]), in which a novel verb appears, for inferring if the verb is denoting a causative or non-causative action (Bunger & Lidz, 2004; Fisher, Hall, Rakowitz, & Gleitman, 1994; Matsuo, Kita, Shinya, Wood, & Naigles, 2012). At issue was whether children understand that transitive verbs involve two participants (i.e., two argument NPs), such as the agent and patient of a causative event, whereas intransitive verbs typically involve only one participant (i.e., one argument NP), such as the experiencer of a non-causative event (Jackendoff, 1990; Levin, 1993; Pinker, 1989). In Naigles (1990), for example, 25-month-olds viewed an event presenting two characters (bunny, duck) who simultaneously performed a causative (the duck made the bunny bend forward) and non-causative (the duck and the bunny each made arm movements) action. While watching the event, children were presented with either a transitive (*Look! The duck is gorping the bunny*) or intransitive (*Look! The duck and the bunny are gorping*) sentence containing an unfamiliar verb (*gorping*). In the subsequent test phase, the causative and non-causative action were split into single scenes so that children watched the causative action on one screen and the non-causative action on another screen. Simultaneously, they were asked to find the target action (*Where's gorping?*). These children who listened to the transitive sentence (*Look! The duck is gorping the bunny*) preferred to look at the screen showing the causative action (the duck made the bunny bend forward), while the children presented with the intransitive sentence (*Look! The duck and the bunny are gorping*) preferred the non-causative action (duck and bunny making arm gestures). A similarly initial understanding for the systematic relation between argument structure and verb meaning was revealed by Fisher and colleagues, showing that even 15-month-olds use the number of arguments to discern the target verb (Jin & Fisher, 2014; similar findings were obtained in 29-month-olds, see Fisher, 2002). They familiarized infants with two events side by side, one showing a caused-motion (e.g. a box caused another box to move) and the second scene a one-participant action (e.g. a ball jumped up and down). Simultaneously, infants listened either to a transitive (e.g. *He's kradding him!*) or intransitive (e.g. *He's kradding!*) sentence containing a novel verb and solely subject and object pronouns. In this way, the identity of the related participants in the event was hidden and it was guaranteed that children interpret the events just by the number of their arguments. The findings showed that the infants looked longer at the caused-motion event when listening to transitive sentences and preferred to look at the one-participant action when presented with the intransitive sentence, even if a second character was presented who was not actively involved in the action. Taken together, these studies show children's early developing ability to use the syntactic structure to determine the meaning of a novel verb.

However, it appears that children's attention to the verb's arguments cause them to establish verb meanings that are closely linked to the particular event participants they perceived when learning the verb. This seems to prevent them from extending the verb meaning to actions of the same kind where the participant object or actor has changed (Imai et al., 2008). Maguire and colleagues, for example, found that children younger than 30 months of age were not able to extend a novel verb they have just learned to an event involving a novel actor (Maguire, Hirsh-Pasek, & Golinkoff, 2006; Maguire, Hirsh-Pasek, Golinkoff, & Brandone, 2008). In light of this result, it was suggested that with respect to the central role arguments play in discerning novel verb meanings children may focus predominantly on the event participants and their specific features, while neglecting the action pattern itself (Kersten & Smith, 2002; Waxman, Lidz, Braun, & Lavin, 2009). Support for this assumption was given by a study showing that 19-month-old infants could learn and generalize a novel verb when specific features of the actor were obliterated while the movement pattern of the action was still perceptible (by using point-light displays). However, they failed to accomplish the task when presented with usual video scenes (Maguire et al., 2002). Based on this, Waxman et al. (2009) assumed that the success in verb learning might depend crucially on how the event participants representing the verb's arguments are depicted in experimental verb learning settings, and they were proved right. In a series of experiments, Waxman and colleagues (Arunachalam & Waxman, 2010; Waxman et al., 2009) familiarized 24-month-olds with simple action events (e.g. man waving a balloon), while they were listening to sentences that either involved a novel verb or noun (e.g. *Look! The man is larping the balloon*, *Look! The man is waving a larp*). At test, children in both conditions viewed two scenes side-by-side: one depicting the familiar actor performing the familiar action on a familiar object and the other one showing the actor performing a novel action on a familiar object. Simultaneously, children in the verb condition heard *Which one is he larping?*, while those in the noun condition listened to *Which one is a larp?* Whereas children in the verb condition demonstrated that they successfully mapped the novel verb to the familiarized action event, the noun condition exhibited no preference, since the object in both test scenes was identical. Thus, children demonstrated the capacity to identify the relevant perceptual information that was labeled by the novel verb in the complex action scene. Furthermore, 24-month-olds showed that they could extend novel verbs to actions involving novel participant objects. When the test phase was modulated so that in one event children viewed the familiar action performed on a new object and in the other one the familiar object in a novel action, children in the verb condition preferred to look at the familiar action-novel object event. Waxman et al.'s studies differed in their design from previous ones and thereby disclosed specific information features that decide whether children succeed or fail in verb learning. On the one hand, infants were familiarized with multiple versions of the actions and sentences, which included participant objects children of this age are familiar with. The involved participant objects in these actions were various kinds (e.g. green, yellow, heart-shaped) of the same object category (balloon), in order for children to be able to abstract the participant object. On the other hand, they received contrast information after the familiarization, which left children with the chance to constrain their novel verb concept toward the target action. Work by Piccin & Waxman (2007, discussed in Waxman et al., 2009, p. 88) in 3-year-olds revealed that each of these factors seems to be required for early verb learning, because when both of them were excluded children learned novel nouns, but not novel verbs. Given this evidence it was decided to adopt and extend Waxman et al.'s design to investigate the empirical questions of the current study (see Chapter 6).

Based on Waxman and colleagues' findings (Arunachalam & Waxman, 2010; Waxman et al., 2009), it can be concluded that 24-month-old children are able to use novel verbs as a 'zoom lens' to highlight particular aspects in their input that form the conceptual underpinning for their verb-concept mapping (Gleitman, 1990; Gleitman & Fisher, 2005). In other words, 24-month-olds have rudimentary knowledge of the fact that verbs refer to relations between entities in an event, which involves that they take into account the event participants as the verb's arguments for verb meaning acquisition. With reference to the current study, it is asked now how this knowledge interacts with children's perception of intrinsic emotional input information in a verb learning setting. It is possible to assume that children's evolving ability to categorize a novel word as a verb should lead them to identify the potential referents of the novel verb in the input and concurrently the intrinsic emotional features these referents convey. This assumption implies that the current stage of verb knowledge may determine to which extent intrinsic emotional information affects children's verb meaning formation.

1.2 Interim summary

At 24 months of age children demonstrate initial understanding that verb meanings depend on the number and relation of their arguments that represent the participants in an event a particular verb is referring to. Thus, it can be assumed that depending on their ability to categorize a novel word as a verb, children may be influenced in their verb meaning formation when perceiving intrinsic emotional information that is conveyed by the event participants.

2 Emotional information processing

Emotional information is a salient cue in our environment (Howe, 2011) that rapidly captures our attention and is argued to be subject to privileged and automatic, i.e., subconscious, processing (Phelps, Ling, & Carrasco, 2006; Vuilleumier & Schwartz, 2001; Yang, Xu, Du, Shi, & Fang, 2011). Prehn and van der Meer (2013, pp. 134–135) define the term *emotion*

> "…as multimodal events in response to a stimulus which has particular significance for the individual, often signifying a potential threat or reward. As one precondition for a specific subjective experience, emotion may include automatic and controlled evaluation of a stimulus. Evaluation occurs whether the stimulus is pleasant or unpleasant, has consequences for personal goals or not, or can be controlled or not […]. In addition to the recognition and evaluation of a stimulus, emotion is characterized by physiological changes, for instance, alterations in skin conductance and heart rate, as well as more complex behavioral tendencies, such as consistent patterns of approach or avoidance." (Prehn & Meer, 2013, pp. 134–135)

Due to the conception that emotions consist of processes of subjective experience and physiological reactions, emotional information is often categorized in terms of the two dimensions *valence* (ranging from negative to positive) and *arousal* (ranging from high to low). While valence characterizes the subjective experience of an external stimulus, arousal determines the physiological change (e.g. Posner, Russell, & Peterson, 2005; Russell, 1980), e.g. pictures depicting people with negative (e.g. angry) facial expressions (valence) elicit larger cardiac deceleration (arousal) than pictures of neutral facial expressions (Bradley, Miccoli, Escrig, & Lang, 2008).

In adults it has been shown that emotional information has modulating effects on their attention, perception, memory, and decision-making. This modulating effect is reflected in an enhanced behavioral performance for emotional as compared to neutral stimuli, e.g. faster detection, more rapid responses, a more robust memory performance etc. (for a review, see Brosch, Scherer, Grandjean, & Sander, 2013). In contrast, there are only few studies in infancy and early childhood reporting modulating effects of emotional information on children's attention, perception, and memory functions. Instead, studies have focused on clarifying by which age children are capable of detecting, discriminating, and recognizing emotional information in their input. The following outline will summarize the developmental course for these capacities and point to some evidence that similar to adult studies shows enhanced attention and processing of emotional information in infancy. With respect to the research questions of the study presented here, the outline will concentrate on the development of processing visual emotional input, i.e., emotional facial expressions.

2.1 Emotional information processing in infancy

Emotion processing requires children to develop different competencies: By *detecting* an emotional expression, children demonstrate that they are sensitive to specific perceptual features of the expression, e.g. exposed teeth of a smiling face. By *discriminating* an emotional expression, they show the competence to differentiate between two emotional expressions, e.g. smiling versus sad face, based on distinguishing perceptual features. By *recognizing* an emotional expression, children are able to relate a person's behavior to the emotional expression he/she displays. This developmental step reflects that children have detected and discriminated the emotional expression, but requires additional knowledge about the correspondence of an emotion expression and the underlying psychological state, i.e., its valence (Walker-Andrews, 1997, p. 437). Thus, emotion recognition is thought of as emotion understanding (Widen & Russel, 2008a, p. 350).

2.1.1 Emotion detection and discrimination

Studies provided consistent empirical evidence indicating that children can detect and distinguish between emotional facial expressions a few months after birth. For instance, infants at the age of three months differentiate between happy and angry facial expressions (Barrera & Maurer, 1981) as well as happy and surprised faces, but cannot discriminate sad from both surprised and happy faces (Young-Browne, Rosenfeld, & Horowitz, 1977). By four months, infants look longer at happy expressions with toothy smiles than sad facial expressions (cited in Oster, 1981) and show longer looking latencies for happy than for angry or neutral faces (LaBarbera, Izard, Vietze, & Parisi, 1976). At the same age, however, they show difficulties in distinguishing angry from neutral faces (LaBarbera et al., 1976) or happy faces with closed mouths from sad ones (cited in Oster, 1981). By five months, infants demonstrate limited abilities to distinguish between sad, fearful, interested, and angry facial expressions (Schwartz, Izard, & Ansul, 1985). At the age of seven months, infants are capable of categorizing happy, but not fearful facial expressions, when they are presented by different people (Nelson & Dolgin, 1985). Beside the fact that infants can detect and discriminate emotional facial expressions, these results indicate that children exhibit better abilities for happy than for other facial expressions in the first seven months. Various reasons for this early ‘happy bias’ were discussed. On the one hand, a study by Caron, Caron, and Myers (1985) revealed that infants younger than eight months seem to rely on significant features in faces for discrimination, e.g. the toothy smile in a happy face, while older infants start to consider the configuration of facial features, e.g. position and relation of eyes and mouth. This result suggests that significant perceptual features in happy faces differ more prominently from negative facial expressions than perceptual features among negative faces. On the other hand, Kahana-Kalman and Walker-Andrews (2001) assumed that infants’ emotion discrimination capacities are influenced by the familiarity of a stimulus. They found that 3.5-month-olds were able to discriminate happy from sad expressions only if they were displayed by their own mothers (similar assumptions were made by Nelson & Dolgin, 1985, suggesting that happy expressions might be more familiar to children than negative ones).

At the age of seven months the processing of facial expressions seems to be subject to developmental change (Grossmann, 2010), which may be ascribed to better visual acuity, contrast sensitivity, and an increased ability to use configurational information (Cohen & Cashon, 2001; Norcia, Tyler, & Hamer, 1990). At this age infants start to pay more attention to negative emotional expressions. Nelson and Dolgin (1985), for example, found that children looked longer at fearful than at happy faces in a visual preference paradigm (see also Ludemann & Nelson, 1988). Similarly, Peltola and colleagues demonstrated that 7-month-olds looked longer at fearful than happy or unfamiliar facial expressions and disengaged their attention less frequently from fearful expressions (Peltola, Leppanen, Palokangas, & Hietanen, 2008). Furthermore, they found that 7-month-olds' but not 5-month-olds' event related potential (ERP) responses to fearful faces were greater than to happy faces (Peltola, Leppanen, Maki, & Hietanen, 2009, see also Nelson & Haan, 1996). Converging results were revealed for angry facial expressions by Grossmann, Striano, and Friederici (2007), although their result suggested that infants' attentional bias for angry expressions starts later than for fearful ones. In their ERP study 7-month-old infants still showed increased responsiveness to happy expressions, whereas the 12-month-olds were more sensitive to angry faces. These findings indicate that in the end of the first year infants start to show a stronger response to negative than positive emotional information, similar to adults. Various studies in adults revealed that negative stimuli (e.g. words, pictures, events) compared to neutral or positive information affected the participants' attention, processing, and judgement more strongly, which is termed *negativity bias* (for a review, see Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). In correspondence with the found negativity bias in adults, LoBue and colleagues observed similar effects in infants. They tested the effect of negative emotional stimuli on the attention of adults, pre-schoolers, and infants using a visual search task (LoBue, 2009; LoBue & DeLoache, 2010). The 8- to 14-month-old infants exhibited a similar performance as the older age groups such that they demonstrated shorter looking latencies for the detection of threatening (e.g. snakes, angry and fearful facial expressions) compared to non-threatening stimuli (e.g. flowers, happy facial expressions). Based on this and further evidence they reviewed, Vaish, Grossmann, and Woodward (2008) propose that these results may be indicative of an early emerging negativity bias, starting in the end of the first year. With respect to these findings, it was decided to use negative emotional stimuli for investigating the research questions of the present study.

Furthermore, it was shown in line with adult studies that emotional information – negative as well as positive – facilitates infants' competence in categorizing perceptual information. A study by Gross and Schwarzer (2010) indicated that 7-month-olds' processing of novel faces was enhanced for faces displaying emotional facial expressions. That is, the children recognized a familiarized face when presented in a novel pose during test only in those cases where the face displayed an emotional expression during the familiarization and test phase.

2.1.2 Emotion recognition

Studies using intermodal matching or social referencing paradigms addressed the question of when children show evidence for emotion recognition. In a series of intermodal matching studies by Walker (1982), for example, children simultaneously viewed two dynamic emotional facial expressions (e.g. happy vs. sad) while a single voice was presented that affectively only matched one of the two expressions. It was found that 5- and 7-month-olds could match the emotional vocal expression with the appropriate facial expression (similar results for angry and interested expressions in 7-month-olds were obtained by Soken & Pick, 1999). Although this finding may give support for a discrete emotion interpretation, infant's reactions do not have to necessarily rely on emotion understanding (Widen & Russel, 2008a). This result might also be explained by children's sensitivity to intermodal correspondence of visual and auditory information, which they frequently encounter in their interactions with adults. In contrast, a more convincing demonstration of rudimentary emotion understanding may have been revealed by social referencing studies in older infants. Here, it was demonstrated that children use others' facial expressions to guide their own behavior. Sorce, Ernde, Campos, and Klinnert (1985) found that most 12-month-olds crawled over a visual cliff (simulating a depth) when their mothers on the other side of the cliff expressed happiness or interest, whereas most infants were hesitant when their mothers displayed a fearful or angry face. In further studies, children were presented with a novel toy toward which an adult expressed different extrinsic emotional signals (facial expressions and vocal sounds). Infants as young as 12 months responded to the referred novel object with selective behavior and a change in their own internal state that corresponded to the adult's emotional signal, i.e., children approached an object when a positive signal was expressed and avoided it in case of a negative expression (Moses et al., 2001; Mumme, Fernald, & Herrera, 1996). Moreover, infants consulted referential extrinsic emotional cues from an adult to disambiguate between two novel objects and used the adult's appraisal to adapt their behavior and affective state to the target object (Moses et al., 2001). Beyond that, they showed selective behavior corresponding to an adult's extrinsic emotional expression even if they were simply observing an event without being actively involved (Mumme & Fernald, 2003). These findings suggest that by 12 months children have an initial understanding of emotion and acknowledge another's intention to convey relevant information by a distinct emotional expression. This understanding seems to enable them to use emotional expressions as a relevant cue for interpreting ambiguous situations and react correspondingly to another's appraisal.

Nevertheless, this initial competence does not tell if children interpret facial expressions in terms of discrete categories, i.e., fear, anger, happiness etc., or broad dimensions, e.g. negative vs. positive or displeasure vs. pleasure. The account by Widen and Russel (2003, 2008a) states that children start with broad categories that are characterized by the two dimensions valence (positive/pleasure, negative/displeasure) and arousal (high, low). In Russel and Widen (2002), for example, children between two and seven years of age were shown photographs of people displaying different emotional facial expressions and were asked to select only those people who felt a target emotion (either happy or angry) the experimenter was looking for. When two-year-olds had to match the photographs with the target emotion 'anger', they selected anger, fear, disgust, and sad faces equally frequently, but rarely positive faces. Moreover, also the older age groups struggled in consistently separating the anger category from other categories of the same emotional valence. The same difficulties across the preschool years were observed for the emotions fear, sadness, and happiness (Widen & Russell, 2008b). These results suggest that the formation of discrete emotion categories is a lengthy process in which broad categories such as happy vs. unhappy are gradually differentiated across development (Widen & Russell, 2003).

2.2 Interim summary

Within the first seven months infants are able to detect and discriminate between stimuli of different emotional valence and show enhancing effects of emotional input information on their attention and processing capacities. At the beginning of their second year children further demonstrate an initial emotion understanding. They interpret the underlying internal state message of another's extrinsic emotional cue to disambiguate unfamiliar situations and to regulate their own affective state and behavior. However, their initial competence might be subject to a broad emotion category understanding, which differentiates across the preschool years. This evidence indicates an early sensitivity to emotional information as well as an understanding of their function, which raises the question of whether this understanding potentially influences early word learning processes.

3 The influence of extrinsic emotional input properties on word learning and memory

To date only a few studies have examined the influence of emotional input information on word learning and memory. These studies have focused exclusively on the effect of extrinsic emotional information; namely emotional prosody and infant directed speech (IDS), which is characterized to be affectively connoted by stronger expressive prosodic features and melodic contours that communicate emotion independently of linguistic information as well (Fernald, 1993; Singh, Morgan, & Best, 2002). The main body of studies has been dedicated to the question whether IDS endorses children to detect words in the speech stream, which is a prerequisite for infusing phonological forms with meaning. The evidence indicates that IDS facilitates infants' word recognition (Singh, Morgan, & White, 2004; Singh, Nestor, Parikh, & Yull, 2009) and word segmentation (Thiessen, Hill, & Saffran, 2005). In these studies, however, children were presented with familiar words in IDS which did not resolve the question whether IDS enhances the learning of novel words. Ma, Golinkoff, Houston, and Hirsh-Pasek (2011) addressed this question in an intermodal preferential looking experiment. They familiarized 21- and 27-month-old children with two unfamiliar objects while the novel nouns that were referring to these objects were presented either in IDS or adult-directed speech (ADS). During a subsequent test phase children were asked to recognize the familiarized objects. The 21-month-olds acquired the novel nouns only when presented with IDS, whereas the 27-month-olds learned the word successfully in the ADS condition. This result suggests that the affective information provided by IDS facilitated children's novel noun learning and interacted with their linguistic competence. That is, the older age group with more sophisticated language learning skills and vocabulary size was less reliant on the affective intonation contours of IDS than the younger participants.

This interpretation is corroborated by findings in a study by Schmitz, Marinos, Friederici, and Klann-Delius (unpublished document). They investigated the influence of positive emotional and neutral prosody on 14-, 20-, and 26-month-olds' learning and memory of novel nouns. Here, children were habituated to 32 different object-word pairs by presenting the novel word toward the referred object with positive or neutral prosody, i.e., an extrinsic emotional cue was employed. Children’s successful mapping of the object-noun pairs was tested immediately after habituation as well as one day later. The findings indicated that the youngest age group was not influenced by either the positive or neutral prosody, but exhibited overall smaller learning and memory effects compared to the older age groups. In the oldest age group, however, the emotional valence affected children’s learning and memory performance differently. Whereas words in positive emotional prosody were better recalled immediately after habituation compared to one day later, the nouns presented with neutral prosody were better retrieved after the one day delay. Thus, in the 26-month-olds with the highest linguistic competence the positive emotional prosody enhanced the attention to and processing of the novel object-noun pairs, but seems to have no effect on memory consolidation processes. This raises the question why the neutrally presented words significantly benefited from sleep. For this issue the authors could not find a plausible answer.

3.1 Interim summary

The aforementioned studies revealed an enhancing influence of emotional input properties on word learning, but they exclusively employed extrinsic auditory emotional cues to explore this influence. The research question in these studies was further limited to the question whether the word-referent mapping is positively affected by emotional input cues, without considering whether the emotional input cues additionally influence the meaning formation of the acquired word, which is the aim to investigate in the present study. Based on the evidence for extrinsic emotional input properties, it can be speculated that intrinsic emotional input properties may have a similar facilitative effect on the mapping process as extrinsic ones. How they might affect the word meaning formation is, on the other hand, an entirely open question.

4 Emotional information, social cognition, and word learning

According to social-pragmatic accounts, "the process of word learning is inherently and thoroughly social" (Tomasello, 2000, p. 401). That is, children learn the meaning of words through interaction with others. This requires children's understanding that others have the intention to communicate with them about aspects in the world (communicative intention) and use extrinsic social cues (e.g. eye gaze, pointing) in guiding their attention toward these aspects to establish joint attention (Bloom, 2000; Tomasello, 2008). Various studies revealed that in the end of their first year of age children show first evidence of this understanding (see the social referencing studies in section 2.1.2; for a review, see Tomasello, 1995) and effectively use it for word learning at the end of their second year (see Ambridge & Lieven, 2011 for a review). The often-quoted study by Baldwin (1993, see also 1991) was one of the first experiments exploring joint attention in word learning. In two different conditions (*discrepant labeling*, *follow-in labeling*) 14- to 19-month-old children were taught novel object labels (e.g. *It's a peri*) while they were playing with one toy and the experimenter with another. In the *discrepant labeling* condition the experimenter uttered the new label when she was looking toward her own toy, whereas in the *follow-in labeling* condition the label was uttered when both experimenter and child were gazing at the child's toy. In a subsequent test phase, children were presented with both toys and asked to recognize the toy labeled earlier (e.g. *Where is the peri?*). It was expected that infants could use the speaker's extrinsic social cue (i.e., eye gaze) successfully when they were able to pass not only the follow-in, but also the discrepant labeling task. Infants of 18 months and above were able to interpret the experimenter's cue in the discrepant as well as follow-in labeling task correctly, while the 16- to 17-month-olds showed more correct word-object mappings than expected by chance only in the follow-in task. Still younger infants were not able to demonstrate successful comprehension in either of the two conditions. This result suggests that the 16- to 17-month-olds relied predominantly on the temporal contiguity between the presented word and the toy to learn the word meaning, what led to false associations in the discrepant-labeling condition. In contrast, the oldest age group considered the attentional cues of the experimenter and, thus, avoided wrong inferences. Beyond that, evidence likewise indicated that 18-month-olds used emotional expressions (vocal cues of disappointment and pleasure) to identify which object an actor intended to label in an ambiguous learning situation (Tomasello, Strosberg, & Akhtar, 1996).

The capacity to recognize intentions, emotions, or desires in others has been labeled variously as *mind-reading*, *social cognition*, *pragmatic understanding*, or *Theory of Mind* and is an essential component in creating joint attentional interactions. An increasing amount of evidence suggests that children in the end of the first year begin to demonstrate an understanding of intentional agency, i.e., they recognize that an actor is following an action plan to pursue a goal (e.g. Baldwin, Baird, Saylor, & Clark, 2001; Sommerville & Woodward, 2005; Spelke, Phillips, & Woodward, 1995; Woodward, 1999). Together with this increasing evidence there is debate whether infants interpret these goal-directed actions without attributing intentional states to the actor (Gergely, Nádasdy, Csibra, & Bíró, 1995) or whether their performance represents an initial understanding of intentions in others (e.g. Saxe, Tenenbaum, & Carey, 2005). Furthermore, it is an ongoing question how this initial understanding results in later-emerging competences of a full-fledged social cognition, i.e., if it is a continuous or discontinuous process (e.g. Wellman & Bartsch, 1994). A detailed discussion on these issues would transcend the scope of the current study (for a recent review and discussion, see Carey, 2009, pp. 157–213). Therefore, in the following, only a few studies are exemplarily cited as evidence for the assumption that children seem to regard an actor's intentional state (e.g. intention to reach a goal) when viewing a goal-directed action, which may be considered as precursor competence of an evolving social cognition. The study by Schlottmann and Surian (1999) can be interpreted as one example. They habituated 9-month-old infants either to a causal or non-causal event. In the causal event, a green square was presented escaping from a red square, while in the non-causal event the red square stopped before the green one started to move. In a following test phase the roles of the squares were reversed, i.e., now the red square was fleeing from the green square. Results revealed that only those infants who were habituated to the causal event showed a dishabituation effect. This suggests that children watching the causal interaction ascribed different roles and action plans to the two squares (similar findings with lower effects even in 7-month-olds are obtained by Rochat, Striano, & Morgan, 2004).

Further evidence for the intentionality assumption is provided by Skerry and Spelke's (2014) study, which suggests that children not only form predictions about an agent's intention by his/her goal-directed movement but also expect that goal outcomes result in specific emotional reactions. In three violation-of-expectation experiments 8- and 10-month-old infants were familiarized with two geometrical characters (two circles) that individually pursued to jump over a barrier to reach a goal location. Since the height of the barrier varied, the characters either failed or succeeded in jumping over the barrier. After each failure or success the character displayed either a positive or negative facial expression that matched (positive-success, negative-failure) or mismatched (positive-failure, negative-success) the goal outcome. Infants at both ages paid more attention (i.e., surprise) to incongruent emotional reactions than to congruent ones, especially in cases where the agent displayed a negative facial expression after successfully achieving the intended goal. In this connection it was also shown that infants did not differentiate between congruent and incongruent emotional reactions when they received no evidence that the character pursued a stable goal, but moved to different goal locations. This result indicates that infants have formed their expectation for a specific emotional reaction based on their expectation about the goal outcome. However, the authors conceded that it is unclear which mechanism provoked infants to form these expectations: Have they considered the intentional state of the agent to predict the appropriate emotional facial expression or have they linked the perceptual facial displays to the goal outcomes without attributing an intention? This issue draws on the debate mentioned above which cannot yet be resolved unequivocally as to whether infants in their first year of age actually attribute internal states to others. Nevertheless, Skerry and Spelke's results indicate that children's representation of intentional agency is closely related to their developing emotion understanding.

Researchers such as Bloom (1993), Franco (1997), and Locke (1995) have argued that prior to language children perceive and share internal states in joint interactions in terms of emotional expressions: "Affect moves infants to socialize and to assimilate the behavior of others; it gives them important personal information to convey before they have language and complex thoughts" (Locke, 1995, p. 329). This is in accordance with the results of the social referencing studies outlined above (see section 2.1.2) as well as Skerry and Spelke's (2014) study, which indicated initial emotion understanding in pre-verbal infants. Further evidence for a transition from affective to linguistic communication is provided by findings in a study by Friend (2001). She investigated the behavioral response of 15-month-olds to an adult's verbal instruction of how to handle an object of joint attention. The adult's instruction (e.g. *Don't touch this*) was accompanied by either congruent (negative) or discrepant (friendly) paralanguage (emotional facial and vocal expressions). As the results revealed, in the discrepant condition infants were better regulated by the adult's paralanguage (friendly) than by the verbal message (*Don't touch this*). However, infants with higher receptive vocabulary responded more frequently in accordance with the verbal instruction than the paralanguage. This suggests that with increasing linguistic knowledge children regard verbal utterances over emotional expressions as an effective tool for regulating others' behaviors with respect to one's own intentions. However, as long as language is not adequately acquired emotional expressions seem to serve as pre-linguistic symbols that are efficiently used by children to express themselves and understand the intentions of others (Bloom, 1998).

4.1 Interim summary

Studies in the context of the social-pragmatic account indicate that by 18 months children regard another's attention and intention conveyed by extrinsic social and emotional cues for word learning. Evidence suggests that the understanding of intentions in others emerges in the end of the first year of age and is related to children's evolving emotion understanding. Before language gradually substitutes their use, children perceive and share internal states (intentions, emotions) through emotional expressions. This suggests that emotional expressions fulfill a placeholder function in communicative settings and might be of special interest for children in early word learning situations. With reference to the present study, it can be asked now whether children consider intrinsically presented emotional expressions similar to extrinsic emotional properties for internal state-reading.

5 Summary and hypotheses

In summary, it can be stated that 24-month-old children learn novel verbs by showing the capacity to identify and categorize an unfamiliar word form and map it onto the relevant perceptual unit of a complex event. When learning novel verbs children use the syntactic structure accompanying a novel verb for narrowing their hypotheses about the potential verb meaning and, in doing so, demonstrate their understanding that verb meanings depend upon the number and relation of their arguments. Moreover, children are able to detect and differentiate emotional expressions at three months of age and show a rudimentary emotion understanding by 12 months. Similar to adults, emotional information enhances children's attention and facilitates their categorization of novel stimuli, but also extrinsic prosodic emotional cues beneficially influence their word learning and memory. Finally, children seem to understand extrinsic emotional cues as expressions of others' underlying internal states, which they consider for word learning by 18 months and for disambiguating unfamiliar situations as early as 12 months of age.

With reference to this empirical evidence, the current study hypothesizes that children's verb learning and memory might also be influenced by intrinsic emotional input properties. As outlined in the introduction, an intrinsic emotional input property is defined as an intrinsic part of an event or referent a novel verb is referring to. For investigating the influence of the emotional input property on verb learning, the +/- friendly facial expression of an actor, performing an action a presented pseudo-verb is referring to, is employed as an intrinsic emotional cue. The present study assumes that children regard the emotional facial expression as conveying an internal state message (e.g. 'anger') of the actor. This internal state-reading process may affect children's verb learning (i.e., attention, encoding) and memory (i.e., retrieval) process, on the one hand. On the other hand, it might influence their verb meaning formation.

It is expected that the assumed influence of the intrinsic input property on the acquisition of verb meanings interacts with children's current state of linguistic knowledge, attentional control, and social cognition (including their emotion understanding) based on the following reasons:

a) Children have to identify the novel pseudo-word as a verb to recognize the actor conveying the emotional input property as the verb's argument.
b) If children identify the novel pseudo-word as a verb, they have to be able to direct and focus their attention on the relevant perceptual information (i.e., the action and the event participants) in their visual input.
c) If children identify the novel pseudo-word as a verb and focus their attention on the relevant information, they have to be able to recognize the emotional valence of the intrinsic input property and relate it to an underlying internal state of the actor.

Based on the empirical evidence outlined above, it is hypothesized that children at 24 months of age are able to identify the syntactic category (i.e., verb) of the presented pseudo-word, can focus their attention on the relevant visual aspects the verb is referring to, and are able to interpret the internal state message of the emotion expression, i.e., its emotional valence (e.g. negative, anger).

To reveal evidence on the question of how 24-month-olds' perception of an intrinsic emotional input property interacts with their verb meaning acquisition, two studies were conducted. In a first study, including a learning and memory experiment, it was investigated if the presented emotional facial expression influences children's learning and memory process while acquiring novel pseudo-verbs. A second study, likewise including a learning and memory experiment, examined whether the actor's emotional facial expression influences children's meaning formation during learning, in that the emotional information constrains how they interpret the verb in a later context.

Empirical Study

6 Remarks on the experimental method

The experimental design of Waxman et al. (2009) was adopted to investigate the formulated research questions. The design is a modified version of the intermodal preferential looking paradigm (IPLP, Hirsh-Pasek & Golinkoff, 1996), which became a reliable method to investigate if infants are able to learn novel word meanings by examining their looking behavior. In the IPLP, children are presented with novel objects or events while listening to a novel auditory stimulus (e.g. *Look at the modi!*) during a training phase. Subsequently, they are tested by showing them two objects/events side-by-side, the familiar versus a novel one, and asked to recognize the familiarized object/event (e.g. *Where's the modi?*). It is assumed that in the case of successful word learning infants prefer to look at the object/event that matches the auditory stimulus they receive (familiarity preference).

Waxman and colleagues (2009) extended the test phase of the IPLP by an additional time window in which a novelty preference was aimed to elicit. The novelty preference is often used to measure children's visual recognition memory in non-verbal experimental tasks (called visual-paired comparison, VPC) and relies on Fantz' (1964) discovery that infants' looking toward a repeatedly presented stimulus decreases over time (familiarization) and concurrently increases for a novel stimulus (novelty preference). In the VPC procedure, infants are first familiarized with a novel stimulus. In the following test phase, the familiarized and a novel stimulus are presented side-by-side. Looking toward the novel stimulus for a longer period (novelty effect) is interpreted as indicating recognition memory, because children recognize that the novel stimulus differs from the familiar one (Pascalis & Haan, 2003). However, systematic variation of the familiarization phase revealed that the length of familiarization time determines whether children show a preference for the repeatedly presented familiar stimulus (familiarity preference) or a novelty preference: briefer exposures during familiarization caused a familiarity effect, longer exposures a novelty effect (Hunter, Ames, & Koopman, 1983; Rose, Gottfried, Melloy-Carminar, & Bridger, 1982). Based on this, it was concluded that a familiarity preference tends to occur when children's mental representation for the familiar stimulus is uncompleted, whereas a novelty effect results from fully encoding (Hunter & Ames, 1988).

In Waxman et al.'s (2009) design, the novelty effect measured in the VPC and the familiarity preference measured by the IPLP are combined to examine children's word learning capacities. Similar to the IPLP children are familiarized with novel nouns or verbs referring to a novel object and event respectively. Subsequently, they are tested by presenting the familiar and a novel object/event side-by-side. The test phase is separated into two sequential time windows. The first window (*baseline*) is created to reveal if children fully encoded the familiarized noun-object/verb-event pair and, thus, demonstrate a preference for the novel stimulus (novelty effect). In the following second window (*response*) children are asked to match the familiarized word with the corresponding object/event. Children's success in word learning is measured by analyzing whether they exhibit an attentional shift from the novel stimulus during baseline toward the familiar stimulus in the response window. The underlying logic of this procedure is that the re-exposure of the familiarized word in the response window should cause a change in children's looking preferences, given that children successfully encoded the verb during familiarization. Hence, if children prefer the novel item during baseline and subsequently change their preference significantly toward the familiarized object/event in the response window, the significant attentional shift can be interpreted as an effect, even if children's performance is similar to a level expected by chance in the response window.

7 Study 1 – The influence of the intrinsic input property on verb learning and memory

The first study investigated the question whether visual emotional input properties affect children's learning and memory of novel verbs. In particular, the aim was to find out (a) whether children map a presented pseudo-verb with the corresponding action successfully during familiarization in order to be able to recognize (learning test) and remember (memory test) the familiar action scene at test, and (b) whether the presentation of an intrinsic input property of negative emotional valence during verb familiarization enhances children's ability to recognize and remember the familiarized action of the corresponding verb at test.

In a learning experiment children were familiarized with different action events. In each event an animate actor (e.g. a man) with either a negative (i.e., angry) or neutral facial expression was acting (e.g. *waving*) continuously on an inanimate object (e.g. a balloon). Each action event was presented with a sentence containing a pseudo-verb corresponding to the action (e.g. Look, the man *is telping* a balloon!). At test, the familiar action and a novel action were depicted simultaneously, while children were asked to recognize the action corresponding to the familiarized verb. In a memory experiment, conducted seven days after learning, it was tested if children are able to remember the familiarized verbs. The influence of the intrinsic emotional input property on learning and memory was tested by modifying the actor's emotional facial expression across conditions. That is, children in one condition were learning verbs while watching actors with negative (i.e., angry) facial expressions, whereas, in another condition they were learning verbs while the actors were presented with a neutral facial expression. The reason for choosing negative instead of positive emotional cues was given by studies reporting a negativity bias that starts to emerge in the end of the first year (Vaish et al., 2008, see Chapter 2.1.1). Therefore, it was assumed to find reliable influential effects rather for negative than positive emotional cues.

7.1 Method

7.1.1 Participants

In total, 86 children were tested. Fourteen children were excluded due to inattention and/or lack of cooperation (n = 9), parental interference (n = 2), experimenter error (n = 1), and low scores on the linguistic assessment (total scores more than two standard deviations below the mean, n = 2). The final sample included 72 children (28 girls) with a mean age of 24.19 months (range: 23.04 – 26.03), who completed all six test trials in the learning and memory experiment. Due to children's sickness (n = 6), the final sample of the memory experiment included 66 children, but only those who had passed the learning test before. Forty-nine of the children were recruited from Hanover, Germany. Since an eye-tracker was not available there, children watched the presented stimuli on a flat-TV screen while their looking behavior was recorded by a camera. The remaining 23 children were recruited from Potsdam and its surrounding communities. These children were tested by using an eye-tracker. Every parent gave informed consent for their child's participation in the study. The consent form has been approved by the ethical committee of the Freie Universität Berlin[3] and the Universität Potsdam respectively.

All children were monolingual learners of German without any hearing problems from middle-class families. Children's receptive linguistic competence was tested using a standardized German language test (SETK-2, Grimm, Aktas, & Frevert, 2000). Their productive language was checked by a parental questionnaire (FRAKIS-K, Szagun, Stumper, & Schramm, 2009; German adaptation of MacArthur CDI). Further, children's social cognition was evaluated by a parental questionnaire (Theory of Mind Inventory, TOMI, Hutchins, Prelock, & Bonazinga, 2012; German adaptation translated and validated by Herzmann, Wexler, & Herrmann, under review; see Appendix E). All children included in the final sample were normally linguistically developed (SETK-2: M = 53.13, SD = 6.86; FRAKIS-K: M = 52.75 words [t-score: 50.1 – 56.7], SD = 25.73) and their social cognition competences (M = 10.86, SD = 3.87) did not differ significantly from the

[3] At the time the data collection in Hanover started, an ethical committee at the Leibniz Universität Hannover did not exist. Hence, the consent form was submitted for approval at the Freie Universität Berlin.

mean score obtained by Herzmann et al. Comparisons of the linguistic (FRAKIS neutral group: M = 54.73, SD = 24.25; FRAKIS negative group: M = 52.23, SD = 23.81; FRAKIS no word group: M = 51.42, SD = 29.47) and social cognition scores (neutral: M = 11.33, SD = 3.51; negative: M = 11.00, SD = 3.43; no word: M = 10.34, SD = 4.56) revealed no differences among the groups, except for the receptive language scores in the two verb learning groups: children in the verb neutral condition demonstrated significantly greater competences (SETK-2: M = 56.06, SD = 7.56) compared to the verb negative condition (SETK-2: M = 50.29, SD = 5.65; $F(2, 69) = 7.71$, $p < .01$).

7.1.2 Materials

7.1.2.1 Visual Stimuli

A set of six video sequences (trials) was created that displayed different events involving live actors performing simple actions (e.g. a man is waving a balloon) with either a neutral or negative (i.e. angry) facial expression (see Appendix A for a complete description of the action scenes presented in the trials). The gender of the actor and the grammatical gender of the involved inanimate objects were counterbalanced. This was necessary, because the gender in German is prominently marked on the definite determiner accompanying the noun. To this end, (a) the live actors were counterbalanced by their biological sex, i.e., three men vs. three women, and (b) every male actor acted on an object marked with masculine, and every female actor was displayed with an object marked with feminine respectively.

All video sequences were recorded at the same location in front of a white wall and edited, subsequently, in size and resolution (720 x 1280 pixels). Each trial lasted approximately 56 sec and was presented to each child against a black background on either a 107 cm (42”) flat-screen or a monitor (17”) of a TOBII 1750 eye-tracker. Although there was a difference in size between the flat-screen and eye-tracker monitor, this difference had no effect on children’s learning and memory performance. This was examined by analyzing the looking behavior of six children before the eye-tracking experiments started. Moreover, the difference of monitor size was tempered with the distance children were seated to the screen. Children tested with the flat-screen were seated 160 cm in front of the screen, the one tested with the eye-tracker 60 cm.

7.1.2.1.1 Rating of the visual stimuli by adults

A rating experiment with 22 students (12 female, mean age: 24.9) from Leibniz Universität Hannover, Germany, was conducted to insure the reliability of the actor's displayed emotional facial expressions in the video sequences. Each adult received five Euro for the participation in the experiment and was asked to rate the actor's facial expression as positive, negative, or neutral by using a Likert scale with a range from '+3' (*positive*) to '-3' (*negative*), with '0' indicating *neutral*. The video sequences were randomized and presented to each rater individually in a single room. The video events depicted the exact same visual information as children watched in the subsequent experiments, however, with the auditory stimuli turned off. As shown in Table 7-1, adults rated the presented negative facial expressions as more negative (M = -1.47, SD = 0.52) than the actors' neutral facial expressions (M = 0.07, SD = 0.42). Both mean scores differed significantly from each other, $t(21) = 14.87$, $p < .001$.

Tab. 7-1: Adults' ratings of the actors' facial expressions

item	neutral	SD	negative	SD
waving balloon	-0.23	0.87	-1.68	0.72
washing cup	-0.09	0.81	-1.64	0.85
twirling umbrella	0.27	0.70	-1.27	0.77
pushing chair	0.41	0.59	-1.00	0.93
pulling box	-0.18	0.66	-1.64	0.79
shaking blanket	0.23	0.61	-1.59	0.66
mean	**0.07**	**0.42**	**-1.47**	**0.52**

7.1.2.1.2 Rating of the visual stimuli by children

Further, a rating experiment with 30 children between four and six years of age (11 girls, mean age: 5.0 years) was carried out to explore whether children recognize the actors' emotional facial expressions presented in the video sequences in the same way as adults do. Children were asked to match the facial expressions of the video actors presented at the top of a PC screen with one of three different facial expressions presented as matching choices below by using a pointing task (the design and procedure was similar to the one used in Herba, Landau, Russell, Ecker, & Phillips, 2006; Szekely et al., 2011). The actors' facial expressions were cut from the video sequences as still faces. In each trial, three matching choices were drawn from a set of six photographs of facial expressions displaying five different emotions (joy, sadness, fear, disgust, anger) and the neutral category, which were taken from the Ekman & Friesen corpus (1976). The faces were masked coercing children to focus on the facial features instead of hair color etc. when matching the facial expressions.

Each actor's negative (i.e. angry) facial expression was presented with one positive (e.g. happy) and two negative facial expressions (e.g. anger and disgust) such that children could either match the target facial expression correctly (i.e., angry with angry) or incorrectly (i.e., choosing happy or disgust). In cases where children selected the incorrect match it was coded if the mismatch was of the same (i.e., disgust) or a different emotional valence (i.e., happy). This served to verify previous findings suggesting that children start with broad categories like negative and positive at the outset, which they gradually differentiate across development (Widen & Russell, 2003, 2008b, see Chapter 2.1.2). Further, each actor's neutral facial expression was presented with a neutral, positive, and negative matching item so that children could match the target correctly or incorrectly by choosing the positive or negative item. To avoid that children develop a bias for the neutral and angry expressions, three different distractor facial expressions displaying sad, fearful, and happy emotions were included. Equally to the angry and neutral facial expressions they were asked to match those with one of three choices. Overall, each child rated nine different facial expressions, i.e., three distractors, three neutral, and three angry facial expressions. To familiarize the children with the matching task, every rating session started by asking the child to match a triangle, rectangle, circle, and cross presented in the top of the screen with the corresponding one of three different geometric choices in the bottom. No child demonstrated any difficulties in accomplishing the task.

The descriptive results revealed that children rated the negative facial expressions correctly more frequently (M = 66.15%, SD = 16.37) than the neutral ones (M = 54.91%, SD = 12.39; see Table 7-2). Moreover, the results indicated that children matched the target angry expressions almost 72% with items of the same emotional valence, what corroborates Widen and Russel's assumption of broad emotional categories in infancy and early pre-school years. Subsequent statistical analyses revealed that children did not perform significantly different for the negative and neutral items, $t(29) = 1.54$, ns. Further, children's ratings were compared against a level of 33.33% (the possibility was 1:3 that they select the correct match) to examine whether they matched the neutral and negative facial expressions correctly more frequently than expected by chance. Their performance with neutral and negative facial expressions differed significantly from chance levels, both t's ≥ 4.08, both p's < .001. Thus, children were able to assign the actors' facial expressions to the corresponding (emotional) category, albeit the neutral category might have caused more difficulties than the negative one as the descriptive results suggest. These findings were considered in the subsequent analyses and discussion of the data.

Tab. 7-2: Children's ratings of the actors' facial expressions (in percent)

item	neutral as neutral (correct)	neutral as negative	angry as angry (correct)	angry as negative
waving balloon	62.50	31.25	64.29	6.22
washing cup	57.14	35.71	62.50	6.40
twirling umbrella	43.75	50.00	42.86	9.33
pushing chair	57.14	28.57	62.50	6.40
pulling box	37.50	43.75	71.43	5.60
shaking blanket	71.43	21.43	93.33	1.07
mean	**54.91**	**35.12**	**66.15**	**5.84**

7.1.2.2 Auditory Stimuli

The six presented pseudo-verbs were created in compliance with the canonical morphological structure of German verbs, i.e., verb stem + inflectional suffix '-en'. Every pseudo-verb was monosyllabic and inflected with the morpheme '–t' in third person singular.

The auditory stimuli were recorded with a female German native speaker who was instructed to pronounce the sentences in infant-directed speech. Her utterances were recorded in a sound-attenuated booth and edited to control amplitude, timing, pitch peaks etc. Subsequently, the auditory stimuli were synchronized with the visual stimuli and presented during test via a hidden loudspeaker, which was placed beside the screen. The software *Adobe Premiere CS5* was used for video editing and audio-video synchronization. For a full description of the auditory stimuli see Appendix B; an exemplary description of one trial for learning and memory is shown in Table 7-3 and 7-4 respectively.

7.1.3 Experimental design

Every child went through one learning and one memory experiment each consisting of six different video trials depicting six different action scenes. The trials were presented in one of two random orders, balanced across conditions. In addition, the order was balanced over the experiments, i.e., children presented with order A for learning were presented with order B for memory and vice versa. The left-right position of the familiar and novel test scene was counterbalanced across trials.
Children were randomly assigned to one of three conditions. In one condition children were learning novel verbs while the presented actions involved actors with neutral facial expressions (verb neutral condition). In the second condition children were learning verbs while watching actors posing negative facial expressions (verb negative condition). In the control condition children were not learning any verb while watching actions that involved actors with neutral facial expressions (no word condition). In all conditions children were presented with the exact same action scenes. The only varying input across conditions were the auditory stimuli as well as the emotional facial expressions of the involved actors.

7.1.3.1 Learning experiment

Each trial of the learning experiment was divided into a familiarization, contrast, and test phase; exemplarily illustrated for one trial in Table 7-3. To capture children's attention every trial started with a short video sequence (4 sec) showing a colorful locomotive driving.

(a) Familiarization (26 sec)

During familiarization children were presented with four consecutive examples of an action event alternately shown on the left or right side of the screen. The left-right presentation was counterbalanced across all six trials. In each of the four event examples the same animate actor (e.g. a man) was performing the same action (e.g. waving) on four different inanimate objects of the same category (e.g., round blue balloon, heart-shaped red balloon, etc.). The auditory information accompanying the event sequences varied depending on the condition (e.g. *Look, the man is telping a balloon!* [verb]; *Look what's happening here!* [no word]).

(b) Contrast phase (14 sec)

In the following contrast phase two scenes were presented to the child consecutively in the center of the screen. First, the same actor (e.g. the man) was enacting a novel action with a novel object (e.g. the man *lifted a hat on head*) accompanied by auditory information that varied by condition (e.g. *Oh, the man is not telping here!* [verb]; *Oh, look at that!* [no word]). Afterwards, the children were presented again with the same actor and the familiarized action (e.g. waving the balloon) while listening to a sentence that varied by condition (e.g. *Ah, the man is telping here!* [verb]; *Ah, look!* [no word]).

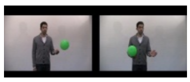
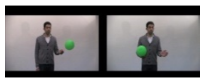
(c) Test phase (12 sec)

In the test phase two action scenes were presented simultaneously side by side on the screen. Both action scenes presented the same actor and object[4], but differed in the kind of action. That is, one scene displayed the actor performing the familiarized action (e.g. waving the balloon), whereas the

[4] The object was one of the four introduced objects of the familiarization phase.

other featured the actor performing a novel action (e.g. *tapping the balloon*). The test phase was divided into a baseline period (4 sec) and a following response period (8 sec) separated by a blank screen (520 ms) and a ringing sound. Both were accompanied by different auditory information: During baseline children of all groups were listening to the same auditory information, e.g. *Look at this!*, but during response they were presented with different information that varied by condition, i.e., children in the verb condition were asked to recognize the scene corresponding to the familiarized verb (e.g. *Where is the man telping the balloon?*), whereas children in the no word condition listened to a sentence containing no novel verb (e.g. *What do you see there?*).[5] See Appendix C for a full description of the temporal structure of each trial in the learning experiment.

Tab. 7-3: Study 1. Example of one trial presented in the learning experiment

				Test	
	Familiarization	**Contrast**		**baseline**	**response**
visual stimuli					
auditory stimuli	**verb condition:** Guck mal, der Mann telpt einen Ballon! *Look! The man is telping a balloon!*	Oh! Hier telpt der Mann nicht! *Oh! The man is not telping here!*	Ah! Hier telpt der Mann! *Ah! The man is telping here!*	Guck mal da! *Look at this!*	Wo telpt der Mann den Ballon? *Where is the man telping the balloon?*
	no word condition: Guck mal was da passiert! *Look what's happening here!*	Oh! Guck mal da! *Oh! Look at that!*	Ah! Sieh mal! *Ah! Look!*	Guck mal da! *Look at this!*	Was siehst du da? *What do you see there?*

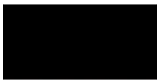
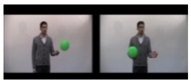
7.1.3.2 Memory experiment

Each trial of the memory experiment included the attention getter, a short reminder, and a test phase (exemplarily depicted by one trial in Table 7-4). After showing the locomotive (4 sec) to capture children's attention, the screen went blank and a reminder question was presented (3.5 sec),

[5] A critical review of the effects that might have been elicited by the question presented in the no word condition will be given in Chapter 7.3.1.1. Since the design was adopted from Waxman et al. (2009) and due to issues of comparability, the question was translated as close as possible to the question presented in English.

e.g. *Do you still remember? The man is telping a balloon*. The aim of this question was to provide children with the opportunity to recall the learned verbs before they were requested to match the auditory information with the visual one. Subsequently, the test phase started, which was identically designed to the one of the learning experiment.

Tab. 7-4: Study 1. Example of one trial presented in the memory experiment

	Question	**Test**	
		baseline	**response**
visual stimuli			
auditory stimuli	**verb condition:** Weißt du noch? Der Mann telpt einen Ballon! *Do you still remember? The man is telping a balloon!*	Guck mal da! *Look at this!*	Wo telpt der Mann den Ballon? *Where is the man telping the balloon?*
	no word condition: Weißt du noch? Du hast etwas geseh'n! *Do you still remember? You saw something.*	Guck mal da! *Look at this!*	Was siehst du da? *What do you see there?*

7.1.4 Apparatus and Procedure

7.1.4.1 Learning experiment

Children and adults were welcomed in the anteroom. While the child was playing, adults were introduced to the procedure of the upcoming experiment. Subsequently, children and adults were guided to the test room where the child was seated on the caretaker's lap. Children who were tested by presenting the videos on a flat-TV were placed 160 cm and the ones tested by eye-tracking were seated 60 cm away from the screen. The caretaker was reminded not to talk or to interact with the child. Subsequently, the experimenter started the video from an adjacent room observing caretaker and child via a monitoring screen during testing.

Throughout the experimental procedure children's looking behavior was recorded for later analysis. In the experiments using the flat-TV, children's looks were recorded (for offline coding) by a camera centered above the screen. In the experiments using an eye-tracker, children's looking behavior was recorded and coded online. To this end, children were presented with a five-point calibration before the video was started.

After the video had ended, the child's linguistic competence was tested employing the SETK-2 (Grimm et al., 2000) and two parental questionnaires to complete (FRAKIS-K, Szagun et al., 2009; TOMI, Hutchins et al., 2012) were given the parents to take home with. Each session lasted between 25 and 40 minutes.

7.1.4.2 Memory experiment

The memory experiment was conducted seven days after the learning test. The procedure was identical to the learning experiment except that children were not tested for their linguistic competence after the video presentation. Instead, parents gave back the completed parental questionnaires. Each session lasted approximately 15 minutes.

7.1.5 Coding of the data recorded by the camera

Children's looking behavior was coded offline with the sound turned off so that coders were unaware of the auditory stimuli. Further, coders neither saw the left-right position of the familiar and novel test scenes nor did they know about the experimental conditions the children were assigned to. For coding the scoring software *Lincoln Lab Package 1.0* developed by Meints and Woodford (2008) was employed. Coders determined for each frame (25 frames per second) whether the child looked at the right scene, left scene, or neither scene.

The looking behavior of all children was coded by one person, whereas another person coded the looking of nine children, i.e., three children per condition. Coder's agreement was calculated afterwards. The coding was in agreement 97.2% of the time for the learning test and 95.1% for the memory test.

7.1.6 Dependent Variables

Based on the coded looking data two within-subject measures were created for later analysis. Each measure was created by cutting out two windows from the test phase: one of the baseline period and one of the response period; each lasting three seconds. The baseline window was identical with the last three seconds of the baseline period. The response window started with the onset of the pseudo-verb presented in the test question (e.g. *Where is the man telping the balloon?*) and ended three seconds later.

a) Proportion of looks toward the familiar test scene

Within each window, for each child and each trial the mean proportion of looks toward the familiar test scene was calculated (total number of looks devoted to the familiar test scene, divided by the total number of looks toward both the familiar and novel test scene).

b) Switches of attention between the familiar and novel test scene

Within each window, for each child and each trial the mean number of switches between the familiar and novel test scene was calculated. This measure may assess something about children's certainty about the match between auditory and visual input (Colombo, Mitchell, & Horowitz, 1988). In this sense, children should switch attention more during the baseline than the response window. In the latter one, they should be more focused on the familiar test scene, given that they learned the familiarized verb successfully.

7.1.7 Predictions

7.1.7.1 Learning test: baseline window

Children across all conditions should look longer at the novel (= novelty effect) than the familiar test scene, because no auditory information requests them to recognize the familiar action. This assumes that children realized there was consistency in the presented actions during familiarization, although different inanimate objects were involved.

7.1.7.2 Learning test: response window

If children in the verb conditions (neutral and negative) mapped the presented pseudo-verb successfully with the corresponding action scene during familiarization, they should show a shift of attention toward the familiar test scene when the test question (*Where is the man telping the balloon?*) is presented. In parallel, their attention should be more focused, which is indicated by more switches of attention in the baseline than in the response window.

Because children in the control condition (no word condition) are not familiarized with any verb, these children should not show any preference for one of the two test scenes and, thus, their performance should not change between the baseline and the response window. Likewise, they should not show any difference in their switches of attention between the two windows.

7.1.7.2.1 Influence of the emotional input property

Compared to the verb neutral group, the verb negative group should demonstrate enhanced learning.

7.1.7.3 Memory test: baseline window

Children might show more attention toward the familiar action scene as compared to the baseline window of the learning experiment if they remember the familiar verb-action pair. Nevertheless, the duration of looking toward the familiar scene should be shorter than during the response window.

7.1.7.4 Memory test: response window

Similar to the predictions for the learning test, children in the verb learning groups should demonstrate a change of looking when the test question (*Where is the man telping the balloon?*) is presented. That is, children should look toward the familiar test scene for longer and switch less between familiar and novel test scene, as long as they have learned the verb and are able to remember it successfully. In contrast, children from the no word group should not show any preference for either of the test scenes. Further, they should demonstrate a similar switching pattern during the baseline and response window.

7.1.7.4.1 Influence of the emotional input property

Parallel to the predictions for the learning test, children in the verb negative condition should demonstrate an enhanced memory effect as compared to those in the verb neutral condition.

7.1.8 Pilot test

In order to prove whether the visual and auditory stimuli are suitable to show a learning pattern similar to the one found in Waxman et al.'s (2009) study, eight children (4 girls and 4 boys, between 22.01 – 24.25 months, mean: 23.51 months) were tested exclusively in the verb neutral condition. It was expected that if learning is successfully elicited by the stimuli used in this study, children should show a substantial difference in their looking behavior between the defined baseline and response window. As results indicated, children demonstrated an attentional shift between baseline and response window suggesting a learning effect. In particular, they looked longer at the familiar test scene in the response window (M = 0.40, SD = 0.07), when asked to recognize the corresponding action of the familiar verb, than in the baseline window (M = 0.35, SD = 0.09). The number of children was determined whose mean looking time during response exceeded that in the baseline window. The distribution was analyzed by a non-parametric binomial test and revealed that significantly more children (7 out of 8) looked toward the familiar test scene during the response window than expected by chance (50%, $p < .05$, one-tailed).

7.2 Results of Study 1

7.2.1 Inclusion criterion

Only children who met the following two criteria were considered for analysis: (a) they completed all six test trials and (b) their performance in the looking task was successfully tracked (eye-tracking) and coded (recorded by camera), respectively, over 60% of the time for at least four trials.

7.2.2 Results of the learning test

As depicted by Figure 7-1, the time-course of children's looking behavior revealed a preference for the novel test scene across all conditions during the first two seconds of the baseline window. In the last two seconds, however, the looking behavior began to vary between groups. Whereas the negative group is still focusing on the novel test item, the verb neutral and no word group tended to be more interested in the familiar item. With the beginning of the response window, i.e., by presenting the test question (e.g. *Where is the man telping the balloon?*), the verb learning groups started to look more frequently toward the familiar test scene whereas the no word group demonstrated no preference for one of the presented action scenes. Despite this difference in looking, children's overall attention (mean number of looks toward the screen) to the presented action scenes was comparable among conditions, $F(2, 69) = 0.62$, ns.

To analyze whether the introduction of novel verbs and the intrinsic emotional input property affected children's looking behavior, two-way analyses of variance (ANOVA)[6] were conducted for each dependent variable, with condition (verb neutral, verb negative, no word) as a between-subject factor and window (baseline, response) as a within-subject factor.[7]

[6] As outlined in Chapter 6, the experimental design of Waxman et al. (2009) was adopted. An identical statistical procedure using ANOVAs was conducted to warrant the comparability of results obtained by Waxman et al. and the present study.
[7] Corresponding to Waxman et al. (2009), only the test phase was analyzed for learning and memory effects. For further discussion on this, see Waxman et al.

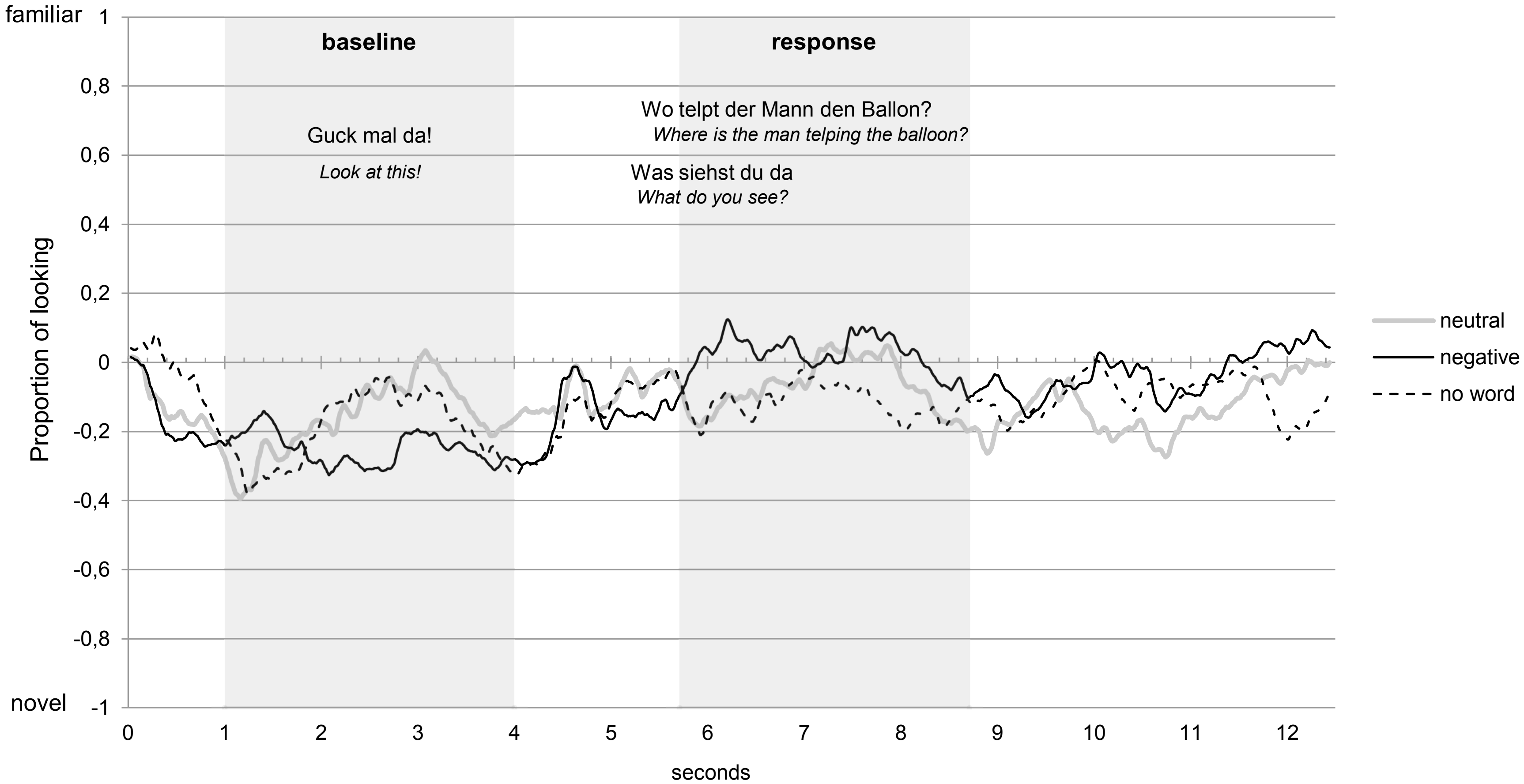


Fig. 7-1: Study 1. Time-course of children's looking behavior in the test phase of the learning experiment, aggregated over all trials

7.2.2.1 Proportion of looks toward the familiar test scene

The two-way ANOVA revealed a main effect for window [$F(1, 69) = 18.47$, $p < .001$, $\eta^2 = .21$], but no main effect for condition [$F(2, 69) = 0.37$, ns]. That is, children looked more frequently toward the familiar test scene during the response than during the baseline window (see Figure 7-2). The ANOVA also yielded a window x condition interaction [$F(2, 69) = 3.63$, $p < .05$, $\eta^2 = .10$]. To address the interaction effect in greater detail, subsequent ANOVAs compared the verb neutral vs. verb negative condition, verb neutral vs. no word condition, and verb negative vs. no word condition. The results indicated significant window x condition effects between the verb negative and verb neutral group [$F(1, 46) = 4.57$, $p < .05$, $\eta^2 = .09$] as well as the verb negative and no word group [$F(1, 46) =5.69$, $p < .05$, $\eta^2 = .11$]. No interaction for the verb neutral vs. no word condition was found [$F(1, 46) = 0.21$, ns]. Furthermore, an analysis of simple main effects was conducted using one-way ANOVAs with a priori contrasts. This revealed that children across all conditions equally preferred to look at the novel test scene during the baseline window [$F(2, 69) = 0.89$, ns], while their performance differed marginally significantly for the response window [$F(2, 69) = 2.78$, $p = .07$, $\eta^2 = .08$]. The a priori contrasts yielded that children in the verb negative condition looked more frequently at the familiar test scene than children in the no word condition ($p < .05$). No similar effect was found comparing the verb negative vs. verb neutral and verb neutral vs. no word condition.

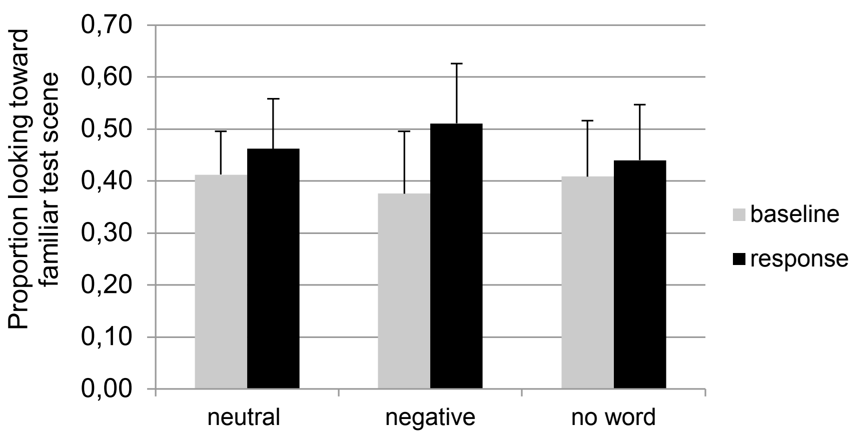


Fig. 7-2: Study 1. Mean proportion of looks toward the familiar scene in the learning test, *Note*: Error bars indicate standard deviations

Beyond that, it was at issue whether children's looking behavior changed from baseline to response window as a result of the re-exposure of the familiarized verb. Therefore, children's looking behavior within each condition was examined by pairwise t-tests with Bonferroni-Holm correction. Children in the no word condition performed comparably in the baseline and response window [M = 0.41 and 0.44, respectively, $t(23) = -1.03$, ns], while the verb neutral group displayed a more pronounced change in looking from baseline to response (M = 0.41 and 0.46, respectively). This was indicated by a marginally significant difference ($t(23) = -1.95$, $p = .06$, $d = 0.55$)[8]. Children in the verb negative condition looked significantly more frequently at the familiar test scene in the response than in the baseline window [M = 0.38 and 0.51, respectively, $t(23) = -4.38$, $p < .001$, d = 1.15]. The different performance across conditions suggests that the presentation of the test question affected children's looking behavior only if they were familiarized with a novel verb. Subsequently, the number of children in each condition was ascertained whose mean looking time during response exceeded that in the baseline window. The distribution in each condition was analyzed by non-parametric tests. The analyses revealed that in the verb negative and neutral condition significantly more children looked toward the familiar test scene during the response window than expected by chance [negative: 19 out of 24, $\chi^2(1) = 8.17$, $p < .01$, neutral: 18 out of 24, $\chi^2(1) = 6.00$, p < .05]. In contrast, the distribution in the no word condition did not differ from chance [16 out of 24, $\chi^2(1) = 2.67$, ns]. Taken together, the results indicated that children's looking behavior in the baseline and response window changed as a function of learning a verb or learning no verb, albeit this change in looking behavior and the proportion of looking to the familiar scene in the response window were greater in the verb negative than the verb neutral group.

7.2.2.2 Item analysis

To examine whether the different learning effect in the verb negative group as compared to the remaining groups was consistent across the six different test trials, item analyses were conducted. The item analyses revealed significant differences between the verb negative and verb neutral

[8] The effect size is indicated by Cohen's d.

group as well as the verb negative and no word group (both *t*'s ≥ 2.75, both *p*'s < .05, both *d*'s ≥ 0.94).

7.2.2.3 Switches of attention between the familiar and novel test scene

The two-way ANOVA revealed a main effect for window [$F(1, 69) = 5.28$, $p < .05$, $\eta^2 = .07$], but no main effect for condition as well as no window x condition interaction (both *F*'s ≤ 0.30, ns). That is, children switched their attention between the familiar and novel test scene more frequently in the baseline than in the response window (see Figure 7-3) while no difference between conditions was found.

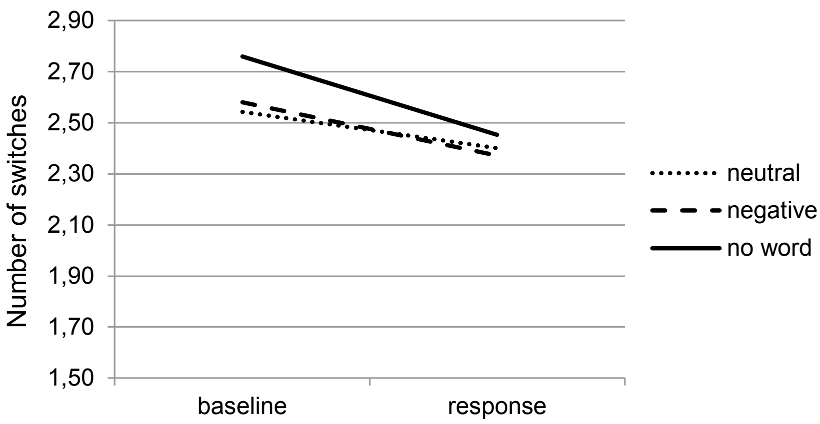


Fig. 7-3: Study 1. Mean number of switches in the learning test

7.2.3 Results of the memory test

To analyze if (a) children could remember the verbs they have learned and (b) if there are differences in memory performance between conditions, two-way ANOVAs were conducted for each dependent variable, with condition (verb neutral, verb negative, no word) as a between-subject factor and window (baseline, response) as a within-subject factor.

7.2.3.1 Proportion of looks toward the familiar test scene

The two-way ANOVA revealed a main effect for window [$F(1, 63) = 11.64$, $p < .01$, $\eta^2 = .16$], but no main effect for condition and no window x condition interaction (both F's ≤ 0.53, ns). This result indicates that children performed comparably across conditions and looked equally more frequently toward the familiar test scene in the response than in the baseline window (see Figure 7-4).[9]

Although no window x condition interaction was found, pairwise t-tests with Bonferroni-Holm correction were conducted subsequently to examine whether the change in looking behavior between baseline and response window (within-subject effect) was more robust in the verb groups as compared to the no word group. The t-tests comparing the looking behavior in each condition yielded significant differences between the baseline and response window in the verb neutral and verb negative condition [both t's ≥ -2.18, both p's $< .05$, both d's ≥ 0.66], but no effect in the no word condition [$t(21) = -1.51$, ns]. Subsequent non-parametric tests, analyzing the distribution of children in each condition whose looking toward the familiar scene in the response window exceeded that of the baseline window, confirmed this result: In the verb learning groups more children looked toward the familiar test scene than it was expected by chance [in both groups 15 out of 22, both $\chi^2(1) = 2.91$, both p's $< .05$]. In contrast, the distribution in the no word condition did not differ significantly from chance level [12 out of 22, $\chi^2(1) = 0.18$, ns].

[9] Children's attention (mean number of looks toward the screen) was comparable across conditions, $F(2, 69) = 0.37$, ns.

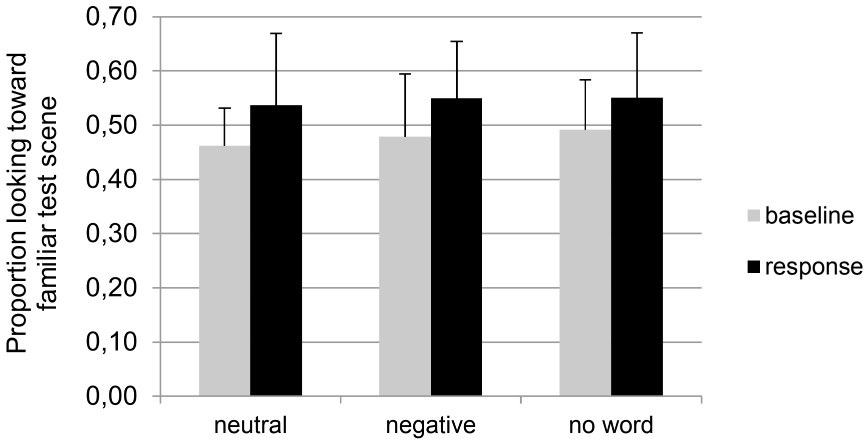


Fig. 7-4: Study 1. Mean proportion of looks toward the familiar scene in the memory test

So it seems that the looking behavior of the two verb groups and the no word group resemble one another in appearance, but might have been caused by different underlying factors: Whereas the verb groups' attention seems to be directed by the presented test question requesting to recognize the verb-action correspondence, the no word group might demonstrate a preference for the test scene they have watched the most, i.e., the familiar one. To resolve this question, a more fine-grained analysis was performed to clarify at which point an increase of looking toward the familiar test scene occurs in each condition. To this end, the response window was divided into smaller windows (bins), each 300 ms in duration. ANOVAs for each bin were conducted comparing the mean proportion of looks toward the familiar test scene between conditions. The ANOVAs revealed no significant differences between conditions (all F's ≤ 0.58, ns), nevertheless, a plain look on the data revealed some interesting insights. As shown in Figure 7-5, the verb neutral and verb negative condition demonstrated an increase of attention toward the familiar test scene around bin five (1200 ms – 1500 ms), which is more evident in the verb negative than in the verb neutral condition. The test question presenting the familiarized verb ended between 1280 ms and 1400 ms, which is falling exactly within the time frame of bin five. Thus, the verb groups' change of attention toward the familiar test scene coincides with the presentation of the test question. This suggests that children in these groups remembered the familiarized verb and endeavored to match the verb with the corresponding action. The test question presented in the no word condition ended after

1000 ms, i.e., in the time window of bin four (900 ms – 1200 ms). However, in contrast to the verb groups, and especially the verb negative group, children in the no word condition did not seem to respond with a similar change of attention, but demonstrated a consistent looking pattern across the critical and subsequent bins.

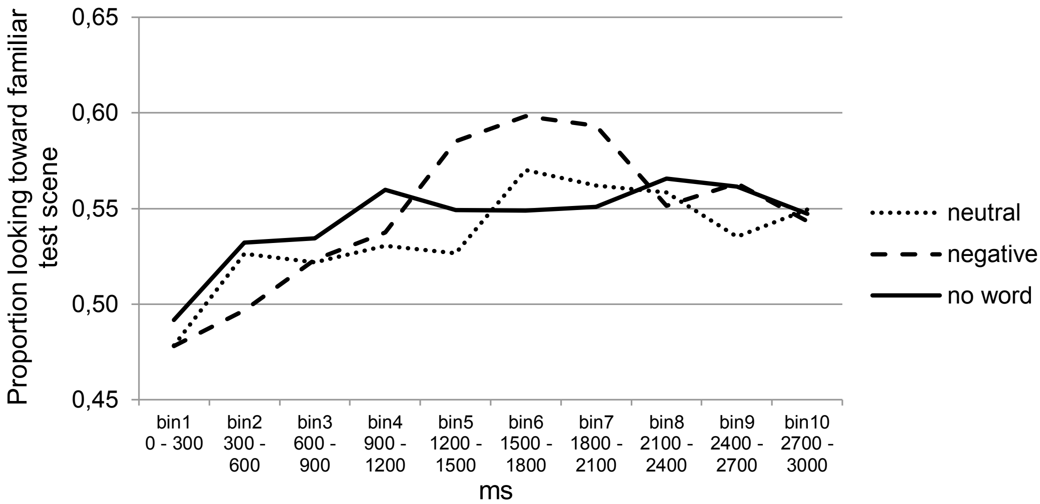


Fig. 7-5: Study 1. Time-course of children's looking behavior in the response window of the memory test, aggregated over all trials

7.2.3.2 Switches of attention between the familiar and novel test scene

The two-way ANOVA revealed a main effect of window [$F(1, 63) = 24.65, p < .001, \eta^2 = .28$] and a marginal effect of condition [$F(2, 63) = 3.02, p = .06, \eta^2 = .09$], but no window x condition interaction [$F(2, 63) = 0.69$, ns]. To address the marginal between-subject effect in greater detail, subsequent two-way ANOVAs compared the verb neutral vs. verb negative condition, verb neutral vs. no word condition, and verb negative vs. no word condition. The results indicated that children in the verb negative condition switched their attention less frequently ($M = 1.92$, $SD = 0.59$) than did those of the no word condition [$M = 2.38$, $SD = 0.59$; $F(1, 42) = 6.51, p < .05, \eta^2 = .13$]. The remaining analyses revealed no results (both F's ≤ 1.55, ns).

The found within-subject effect across all conditions constituted an inconsistency: Although children from the no word group were not familiarized with any verb during learning, they displayed a similar pattern as the verb learning groups during the memory test, i.e., compared to the baseline window they were more focused on the familiar test scene when presented with the test question in the response window (see Figure 7-6). To address this ambiguity, a two-way ANOVA was conducted comparing the mean number of switches during the baseline and response window in the learning test with the mean number of switches in the memory test (as within-subject factor) between conditions. The ANOVA revealed a main effect for test [$F(1, 63) = 16.68$, $p < .001$, $\eta^2 = .21$], but no main effect for condition and no window x condition interaction (both F's ≤ 1.92, ns). That is, all groups switched their attention more frequently during the learning test.

Although no window x condition interaction was found, pairwise t-tests with Bonferroni-Holm correction were performed subsequently to examine whether the within-subject effect (i.e., the mean number of switches during the learning and memory test) was more robust in the verb groups as compared to the no word group. These analyses revealed for the verb neutral and verb negative condition significant more switches in the learning than in the memory test [both t's $\geq$ 2.46, both p's $< .05$, both d's ≥ 0.51], which was not found for the no word group [$t(21) = 1.09$, ns]. That is, the significant decrease of switches in the verb learning groups might indicate a memory effect for the familiarized verb, whereas the no word condition shows a preference for the action they have watched most often.

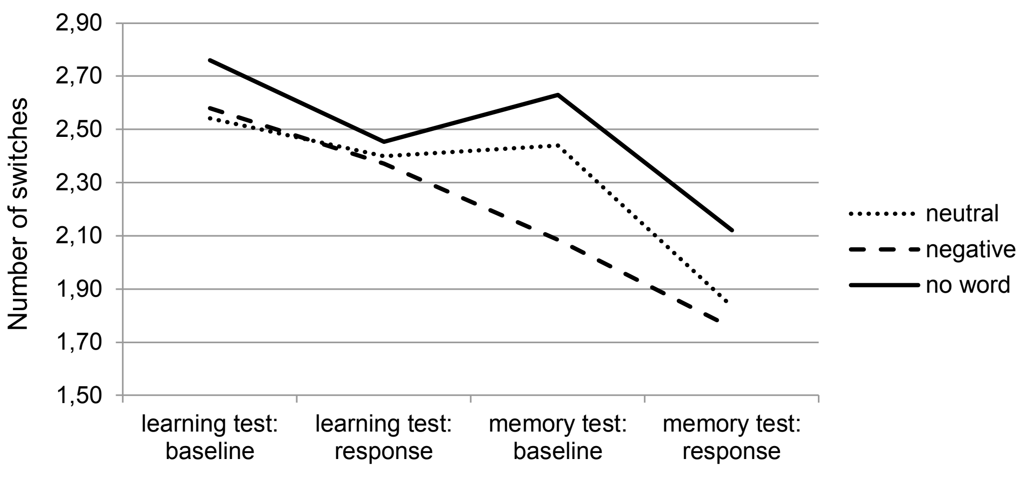


Fig. 7-6: Study 1. Mean number of switches in the learning and memory test

7.2.4 Summary of the results of Study 1

Aim of this experiment was to explore whether a visual emotional input property, i.e., the visual facial expression of an actor, influences the learning and memory of novel verbs. To this end, it was analyzed (a) whether children are able to learn and remember novel verbs successfully by the employed experimental design and (b) whether the negative emotional input property facilitated verb learning and memory.

7.2.4.1 Learning test

As expected, children in the verb neutral and verb negative condition changed their looking behavior depending on the re-exposure of the familiarized verb. They switched their attention more frequently and looked longer at the novel scene in the baseline window. In contrast, they switched their attention less and looked more frequently at the familiar action scene when asked to recognize the familiar verb in the response window. This shift in visual attention from the novel item during the baseline toward the familiar item in the response window was assumed to indicate successful verb learning (see Chapter 6). This interpretation is supported by the finding that children learning no verb (no word condition) did not show a reliable shift of attention during both windows. Beyond that, the results revealed that the learning effect of the verb neutral group did not reach significance and was only suggested by non-parametric analyses. Additionally, the attentional shift of the verb neutral group toward the familiar action scene during the response window did not differ significantly from the performance of the no word condition. In contrast, children in the verb negative group demonstrated a significant learning effect that was characterized by a greater preference for the novel action scene during baseline and more frequent looks toward the familiar scene in the response window, which differed significantly from the performance of the no word and verb neutral group. This increased attentional shift from baseline to response window suggests that the negative emotional input property facilitated children's ability to learn the novel verbs.

7.2.4.2 Memory test

Unlike than predicted, children in the no word condition shifted their attention from the novel scene during the baseline toward the familiar item during the response window. This performance accounted for the fact that no significant difference between the no word group and the verb learning groups during the response window was found. Since children in the no word condition did not learn any verb, it was assumed that their shift toward the familiar item reflects a preference for the scene they were presented with more frequently. More fine-grained analyses supported this interpretation. Compared to the verb learning groups, the attentional shift toward the familiar item was not significant in the no word condition, since children did not devote more attention to the familiar test scene in response to the test question. Additionally, the analysis of switches revealed that the no word group exhibited no decrease of attention shifting across the learning and memory experiment as it was found for the verb learning groups. This may be evidence for the assumption that the looking behavior of the no word group reflects different processes than those underlying the looking behavior of the verb learning groups.

As predicted, children from the verb neutral and verb negative group paid equally more attention to the familiar test scene in the response than in the baseline window, which may indicate a memory effect for the familiarized verb. However, against the background of the similar performance of the no word group, this result is vague and requires further investigation. The fine-grained analysis of the response window revealed that children in the verb negative group exhibited more looking toward the familiar scene than those in the verb neutral group after the test question had ended. This difference, however, did not show up as a statistical effect. Furthermore, children in the verb negative group demonstrated less switches of attention across the baseline and response window suggesting faster and more robust memory of the familiar action event. However, this performance only significantly differed in comparison to the no word group, while no difference was found when comparing the verb negative and neutral condition. Taken together, a marginally enhancing effect of the emotional input property on children's memory performance might be cautiously assumed by means of the descriptive results.

7.3 Discussion

7.3.1 Review of the experimental design

In parallel to findings in English, the adopted experimental design of Waxman et al. (2009) was suitable to reveal a reliable verb learning effect in German acquiring children. Further, it seems that also a memory effect has been revealed in the verb learning groups, which has not been investigated by Waxman and colleagues before. Nevertheless, there are several limitations to the memory results, which may be ascribed to the chosen experimental method. As outlined in Chapter 6, successful verb learning and memory was measured by an attentional shift children demonstrate by their preference for the novel item during the baseline window and increased attention to the familiar item in the response window. Thus, the magnitude of the learning and memory effect was subject to children's novelty and familiarity preferences. However, there is empirical evidence now indicating that these effects are changing as a function of different factors in the experimental design: (a) the length of familiarization, (b) the interval of memory retrieval, and (c) the presentation of a reminder. These factors may offer an explanation to the found inconsistencies in children's memory performance.

7.3.1.1 Why did the no word group demonstrate an attentional shift in the memory test?

Although children in the no word group were not presented with any novel verb in the learning experiment, they demonstrated a similar attentional shift from the baseline to the response window during the memory test as the verb learning groups. One reason for this reaction might be that the length of familiarization elicited a preference effect in these children. In the familiarization phase of the current learning experiment, children watched the familiar action scene 30 sec in total, which may be sufficient time to establish a memory trace for the action scene in the 24-month-olds. Studies with 1- and 2-year-olds have revealed that already 10 sec of visual object presentation elicit memory retrieval after a 1-week delay (Imuta, Scarf, & Hayne, 2013; Morgan & Hayne, 2006).

Similar to the present study, these studies revealed a novelty effect indicating memory retrieval by presenting a reminder question. Likewise as in the current study, the employed reminder question did not mention specific details of the presented stimuli (in the no word condition it was asked *Do you still remember? You saw something,* see Table 7-4 in section 7.1.3.2). That is, even without listening to specific key information, which might have triggered memory retrieval, children showed a robust memory for the familiar action scene. Based on these results, one may assume that the frequent exposure of the familiar action event during the learning experiment caused children to form a stable representation of the familiar action scene. In the memory test, children's memory of the familiar action scene was reactivated by the reminder question and resulted in a weak novelty preference, which is only revealed when children recognize that the novel action scene differs from their stored representation of the familiar scene. The memory effect may have been additionally promoted by the fact that children were tested in the same room during the learning and memory experiment. Several studies found that children up to the age of 18 months re-activate memory significantly better under identical testing conditions (DeFrancisco & Rovee-Collier, 2008; Herbert & Hayne, 2000).

Furthermore, the attentional shift in the no word condition might have been caused by the test question (*What do you see there?,* see Table 7-4 in section 7.1.3.2) presented during the response window. Children might have interpreted this question as a request to focus predominantly on the familiar test scene. Thus, they shifted their attention from the novel scene during the baseline toward the familiar scene in the response window. As already mentioned, the design was adopted from Waxman et al., who ran the study in English. The question in the English design was translated into German as close as possible. In further studies, a question should be created that prevents children from regarding it as a request to behave in a certain way.

Moreover, if the familiarization time during the learning experiment contributed to the attentional shift during the memory test, why was no similar shift found in the learning test? First of all, a marginal shift from baseline to response was also evident in the learning test, which may be indicative of the fact that the familiarization phase in the learning experiment provided sufficient time to habituate the no word group to the familiar action scene. However, a reason for the stronger attentional shift in the memory compared to the learning test may be that children's performance in both tests was mediated by different memory systems. These memory systems are the explicit memory, on the one hand, and the implicit memory, on the other hand. The explicit (or declarative) memory is located in medial temporal lobe regions and involves capacities for recognition and recollection of previous events, dates, facts. The implicit (or non-declarative) memory encompasses different neural systems that are considered responsible for subconscious, procedural information processing such as learning and remembering skills and habits, priming, or conditioning (Bauer, Larkina, & Deocampo, 2010, p. 155; Schneider, 2010, p. 349). Snyder (2007, p. 180) proposes that the novelty effect revealed after familiarization is elicited by "repetition suppression in the visual processing pathway, a phenomenon thought to underlie implicit memory" (Snyder, 2007, p. 180). Repetition suppression defines a process where the neural response for a repeatedly presented stimulus decreases so that the presentation of a novel stimulus initiates a greater neural activation that biases the child's looking behavior toward the novel stimulus (Snyder, Blank, & Marsolek, 2008; Snyder & Torrence, 2009). This assumption contradicts approaches suggesting that the novelty effect relies on explicit memory (e.g. Richmond, Colombo, & Hayne, 2007). To support her assumption, Snyder referred to results from studies in human adults and nonhuman primates with medial temporal lobe (MTL) lesions (in Snyder, 2007, pp. 182–186). Lesion patients demonstrated similar novelty effects (i.e., recognition memory) in the VPC relative to controls when the delay between familiarization and test was 0.5 sec, but showed impaired reactions after two minutes and one hour. Likewise, nonhuman primates with MTL lesions performed similar to controls when the delay was less than 60 sec. Moreover, Snyders' own research in infants (Snyder, Stolarova, and Nelson, 2006, reported in Synder, 2007, pp. 193–195) revealed that 6-month-olds' novelty preferences for faces and objects were associated with a reduction in neural activity as it is predicted by the hypothesis of repetition suppression. These results prompted Snyder and colleagues to assume that the medial temporal lobe contribute to information processing in the long-term memory, whereas the novelty effect after very short delays primarily indicates the competition of visual processing capacities (i.e., repetition suppression) independent from declarative memory (Snyder, 2007, p. 188; Snyder & Torrence, 2009, p. 214). Transferring this assumption to the current results, one may assume the following: During familiarization children in the no word group had sufficient time to encode the visual action scene. In the test phase, which followed only 640 ms after the last presentation of the familiar scene in the contrast phase (see Appendix C), the no word group exhibited increased looking toward the novel scene during the baseline window due to the postulated repetition suppression. Since children of this group were not asked to match the familiarized verb with the corresponding action scene in the subsequent response window, they had no reason for shifting their attention toward the familiar item. In the memory test, however, the reminder (*Do you still remember?…*) and test question (*What do you see there?*) activated retrieval of the stored representation from explicit long-term memory resulting in increased comparing between the novel and familiar scene during baseline (indicated by the switches of attention) and a familiarity preference during the response window.

7.3.1.2 Does the attentional shift of the verb learning groups demonstrate verb memory?

Even though the no word and verb learning groups displayed similar patterns in their looking behavior, the switches of attention as well as the fine-grained analysis of the response window suggest that the looking behavior among the groups was subject to different cognitive processes. In contrast to the no word group, the verb learning groups switched their attention significantly less in the memory test compared to the learning test. This may indicate that their looking behavior was a direct response to the presented reminder and test question, which caused them to focus more frequently on the action scene that matched the familiarized verb. Results of a study by Colombo et al. (1988) indicated that children shifted their attention more frequently when presented with similar stimuli as compared to cases where they viewed discrepant stimuli. With respect to the current findings, this would suggest that the presentation of the familiarized verb might have provoked children in the verb learning groups to regard the scene that matches the familiar verb as more discrepant from the novel scene than children in the no word condition, who received no auditory input that assisted them in contrasting both scenes. This interpretation is supported by the finding that the verb learning groups responded immediately to the test question by shifting their attention toward the familiar scene, whereas the no word group maintained their level of attention. Nevertheless, it is possible to ask why the memory effect in the verb learning groups did not emerge more strongly as compared to the no word group. Potential reasons for this may be the fixed length of the presented stimuli during familiarization, the individual processing speed of each child, and the complexity of the stimuli (Pascalis & Haan, 2003). As findings show, children individually vary in their habituation times indicating different processing speed, which in turn affects the extent of completed encoding (Colombo & Mitchell, 1990; Smith & Yu, 2013). Thus, children who are familiarized with a stimulus to the same amount of time may vary substantially in their ability to optimally encode the stimulus. This factor is not taken into account by the fixed-trial procedure used here. Furthermore, the animated video stimuli were complex and they were presented within a challenging learning task. This may have additionally increased the required processing time (Hunter et al., 1983; Sophian, 1980). Thus, both factors might have led to variability in the completeness of children's verb concepts, which in turn resulted in more heterogeneous looking preferences within the memory test. If these factors influenced children's memory performance, the relatively small number of subjects in the memory test ($n = 22$) might have been insufficient to compensate this variability. Why this variability in encoding did not affect the learning results, could be answered in a similar way as outlined for the results of the no word group above (see section 7.3.1.1): The revealed looking preferences in the learning and memory test might have been mediated by different memory systems. Whereas the learning effect may rely on mechanisms underlying implicit memory as suggested by Snyder (2007), the memory effect after the one week delay may be served by explicit memory.

To test more directly whether the looking behavior among the verb learning groups and the no word group is subject to different cognitive processes, the test question presented during the response window of the memory test could be changed. Instead of the familiar verb, a novel verb could be presented to the verb learning groups, which they have not heard during the learning experiment. Given that children successfully remember the correspondence between the action scene and the familiar verb, they might assume that the novel verb refers to the novel action scene. Thus, an attentional shift toward the familiar action scene should not occur. In contrast, the no word condition presented with any novel information might show the already observed attentional shift. Furthermore, using EEG would provide the opportunity to study whether children in the verb learning groups show a shift from novel to familiar item based on a lexical activation/semantic integration of the presented word (Friedrich & Friederici, 2005).

7.3.2 The effect of the intrinsic emotional input property on learning and memory

Although their linguistic competence was significantly lower, children in the verb negative group showed significantly facilitated learning and marginally enhanced memory performances (suggested by the attentional switches- and bin-analyses) as compared to the verb neutral group. This is consistent with previous findings indicating that emotional stimuli enhance cognitive processing in children and adults (see Chapter 2 and 3). The current results suggest that the word learning (i.e., attention and encoding) process is beneficially influenced by the intrinsic emotional input property, but they leave vague to what extent memory consolidation and retrieval processes were affected by the emotional input cue.

Since children's overall attention to the presented stimuli did not differ among conditions and also no methods were used to control children's neural (e.g. EEG) or physiological (e.g. heart rate) response to the perceived stimuli, it is not possible to relate children's enhanced performances to an increased level of attention. To address this issue in detail, methods to control children's attention by their neural or physiological response should be taken into consideration for further investigations. Richards and colleagues (Richards, 2003; Richards & Turner, 2001), for example, demonstrated that children's heart rate deceleration and a specific event-related potential, labeled *Negative central* (Nc), were correlated with their level of focused attention. A further study, which used ERP measures and the visual preference paradigm simultaneously, indicated that infants' Nc component was associated with their novelty preferences. That is, a greater Nc amplitude occurred when infants were attentive to novel stimuli, whereas the amplitude did not increase when children focused on familiar stimuli (Reynolds, Courage, & Richards, 2010).

Despite this open issue, it is possible to assume an enhancing effect of the negative emotional input information on children's verb encoding. Previous studies analyzing children's novelty and familiarity preferences revealed that longer familiarization times and less complex stimuli increase the novelty effect (Caron & Caron, 1968, 1969; Hunter et al., 1983). Based on these results, Hunter and Ames (1988) postulated that an increased novelty effect results from better encoding. Thus, the enhanced novelty (during baseline) and familiarity preferences (during response) demonstrated by the verb negative group in the learning test suggest the conclusion that the intrinsic emotional information facilitated this group's encoding of the presented pseudo-verbs. With regard to the memory results, however, the marginal differences in the looking behavior between the neutral and negative verb group do not allow us to draw conclusions about an enhancing effect of the emotional input cue on verb consolidation and retrieval processes. The verb negative group demonstrated a reduced number of switches in the memory test as well as distinct looking toward the familiar action scene after the presentation of the test question, which both may be indicative of better verb consolidation and retrieval. However, even if this trend may point to an enhanced effect, it is not possible to distinguish whether the emotional information modulated either consolidation or retrieval of the verb's concept or affected both, because children were presented with the negative input cue also during the memory test. To obtain a more detailed result on this question, one should explore whether children learning a verb in the negative condition will show better memory performances, even if the emotional input information is absent during memory retrieval.

Schmitz et al. (unpublished document) found a similarly decreased influence of an emotional input property on children's word memory as compared to their word learning. Their results indicated enhanced learning of nouns presented with positive prosody compared to nouns presented with neutral prosody, but a reversed memory effect one day later (see Chapter 3). This similar finding suggests that the emotional information is subject to alteration in the consolidation process of long-term memory (Bauer, 2004). However, one may ask why Schmitz et al. found a reversed effect, whereas the present study revealed a diminished effect. On the one hand, it is possible that the way the stimuli were presented during the memory test in both studies influenced children's memory retrieval. As mentioned above, children in the current study were presented with the identical emotional facial information during the learning and memory test, whereas in the study by Schmitz et al. the emotional information was absent in the memory task. In this way, the emotional information in the present study might have affected children's memory retrieval, leading to a marginally increased memory performance, while children's verb consolidation in the present study as well as in Schmitz et al.'s study remained unaffected by the emotional input property. On the other hand, the negative emotional valence of the presented input cue might have caused that children showed a reduced, but not a reversed memory effect. According to evolutionary and functional accounts, stimuli in the environment can be associated with positive (e.g. reward, comfort) and negative (e.g. threat, punishment) experiences by an individual and, in this way, provide essential information for the individual's well-being (e.g. Rolls, 2005; Tooby & Cosmides, 2008). Whereas positive emotions confirm continuing an activity, negative emotions provoke a rapid termination; otherwise, a negative experience would follow. Hence, it is proposed that stimuli associated with negative emotions receive privileged attention and processing as studies in adults and infants empirically supported (e.g. Öhman et al., 2001; Pratto & John, 1991; see also section 2.1.1). Thus, children in the present study might have been more affected in their processing and storing of the presented verbs by the emotional input property than children in the Schmitz et al. study, which employed positive input information. The stronger effect might have been additionally reinforced by the way the emotional information was presented: Schmitz et al. used an extrinsic prosodic input cue, which had no potential to be considered by children as part of the word meaning. These assumptions require further investigations, which examine systematically how children's verb learning and memory processes interact with intrinsic emotional input cues of different emotional valence in order to contrast these results with the current performance of the verb negative group. For example, these experiments should involve (a) another control group, where children are not learning any verb, but are presented with a negative emotional input cue, and (b) a positive emotional condition.

Taken together, the present findings warrant replication and as the memory results revealed no reliable differences between the two verb learning groups, no conclusion regarding an enhancing effect of emotional information on lexical long-term consolidation and retrieval is drawn.

8 Study 2 – The influence of the intrinsic input property on verb meaning formation

The results of Study 1 suggest that the intrinsic emotional input property enhances the learning of novel verbs in 24-month-old children. Because of this finding, Study 2 was designed to investigate (a) whether the intrinsic emotional input property affects the content of novel verbs that are learned, i.e., the verbs' meaning, and (b) whether the influence of the intrinsic input property on children's verb meaning formation interacts with the amount of attention children pay to the intrinsic input property while learning the verb.

As outlined in Chapter 5, the current study assumes that the influence of the intrinsic emotional input property on children's verb learning is subject to an internal state-reading process. For example, when children are presented with an action scene as in Study 1, which displays an actor's facial expression while the actor is performing an action, a potential reference frame for the interpretation of an internal state message (e.g. *anger*) is established. If children associate their interpretation of the internal state message 'anger' with the action (e.g. *waving a balloon*) a novel verb (e.g. *telping*) is referring to, this may result in a meaning like *negative* (e.g. threatening, punitive) *waving* for the novel verb. Based on this, it can be hypothesized that children who learned a novel verb in an emotionally negative context (e.g. actor with angry facial expression) may prefer to attribute a negative meaning to this verb in later situations. To test this assumption, the experimental design of Study 1 was adopted, however, changed for the memory test and the number of subject groups. In a learning experiment, two groups of children, i.e., a verb neutral and a verb negative group, were familiarized with novel-pseudo verbs and tested for successful verb learning. In a memory test after one week, children were presented with two action scenes side-by-side which were identical in the displayed action, but differed in the actor's facial expression. It was assumed that children would prioritize the action scene displaying the facial expression they were viewing while learning the verb if the emotional input property influenced their verb meaning formation.

In contrast to Study 1, children's looking behavior was recorded with an eye-tracker to analyze whether the influence of the emotional input property interacts with children's attention: First, it was examined in greater detail whether children in the negative and neutral condition attended differently to the presented action scenes while learning and remembering novel verbs. The attention parameter (proportion of looks) chosen in Study 1 did not reveal any differences between the conditions. To this end, children's attention in Study 2 was assessed via three different measures, i.e., the longest fixation, the mean duration of fixations, and the number of fixations. These measures were used in different studies providing evidence that children's looking duration is associated with their level of attention (Jankowski & Rose, 1997; Rose, Futterweit, & Jankowski, 1999). Second, it was investigated whether children's attention to the intrinsic input property (the actor's facial expression) in the learning experiment varied as a function of the displayed emotional valence (negative vs. neutral) and determined children's performance during memory. On the one hand, it was assumed that the negative input property elicits more attention to the actor's face. On the other hand, it was expected that the amount of attention children pay to the intrinsic input property while learning a novel verb influences how children interpret the verb in the memory test. To examine these issues, children's number of looks toward the actor's facial expression was measured.

For both parameters of attention, i.e., visual attention toward the action scene and looks toward the intrinsic input property (actor's facial expression), it was assumed that longer and more frequent fixations/looks indicate increased attention and processing of the presented stimuli. The assumption was based on evidence suggesting that longer visual latencies in the second year of life reflect increasing capacities to voluntarily control the attentional scope (executive attention) and focus on an object of interest while neglecting peripheral information (Colombo & Cheatham, 2006; Reynolds, Courage, & Richards, 2013).

In sum, the second experiment pursued four objectives. First, it was explored if the emotional input information influenced children's verb learning, i.e., encoding processes. Second, it was examined whether the intrinsic input property affects children's verb meaning formation so that in the memory test children prefer the action scene that displayed the emotional facial expression they were watching while learning the verb. Third, it was investigated whether children's attention to the presented action events and the intrinsic input property varies as a function of emotional valence. Fourth, it was analyzed whether the amount of attention children pay individually to the intrinsic input property (the actor's facial expression) while learning the verbs determines their looking performance and verb interpretation in the memory test. With respect to the results of Study 1, it was assumed that the verb negative as compared to the verb neutral group shows enhanced learning, increased attention, and a preference for the action event displaying the actor with negative facial expression when asked to remember the familiarized verb during the memory test.

8.1 Method

8.1.1 Participants

In total, 61 children were tested, who were recruited from Potsdam and its surrounding communities. Thirteen children were excluded due to inattention and/or lack of cooperation during the stimuli presentation (n = 8), parental interference (n = 1), lack of cooperation during the linguistic competence test (n = 1) and illness (n = 3). The final sample included 48 children (23 girls) with a mean age of 23.94 months (range: 23.06 – 25.28), who completed all six test trials in the learning and memory experiment. All children were monolingual learners of German without any hearing problems from middle-class families. Every parent gave informed consent for their child to participate in the study. The consent form has been approved by the ethical committee of the Universität Potsdam.

As in Study 1, children's receptive language was tested using the SETK-2 and their productive competence additionally checked by the short parental questionnaire FRAKIS-K. Further, children's social cognition was evaluated by the parental questionnaire TOMI. All children included in the final sample were normally linguistically developed (SETK-2: M = 53.79, SD =

6.64; FRAKIS-K: *M* = 51.44 words [t-score: 50.1 – 56.7], *SD* = 28.96). However, their TOMI scores (*M* = 8.46, *SD* = 2.61) were more than one standard deviation below the mean obtained by Herzmann et al. (under review), although both experimental conditions were comparable in their TOMI scores (neutral: *M* = 8.88, *SD* = 2.75; negative: *M* = 8.02, *SD* = 2.44).[10] Likewise, both conditions demonstrated comparable receptive and productive language skills (neutral: *M* = 53.02, *SD* = 7.00 [SETK-2], *M* = 56.08, *SD* = 29.54 [FRAKIS]; negative: *M* = 54.59, *SD* = 6.30 [SETK-2], *M* = 46.36, *SD* = 28.10 [FRAKIS]).

8.1.2 Materials

The employed visual and auditory stimuli were identical to those in Study 1, except for one visual action event that was changed. The event displayed a woman pulling a box. Her facial expression was far from the camera and difficult to recognize. With respect to the aim to analyze children's attention to the displayed facial expressions, this trial was considered to be inadequate for exploring this question. Therefore, the same woman was recorded performing a novel action (tossing a box) while displaying a neutral and negative facial expression respectively. The displayed facial expressions of this novel trial were rated by 22 students using a Likert scale with a range from '+3' (*positive*) to '-3' (*negative*), with '0' indicating *neutral*. The results revealed that the neutral facial expression was rated more frequently as neutral (*M* = -0.41, *SD* = 0.59) than the negative facial expression [*M* = -2.05, *SD* = 0.79; $t(21) = 13.21$, $p < .001$]. See Appendix D for the complete set of visual stimuli used in Study 2.

[10] Three factors might have played a role in the current study obtaining lower mean scores. First, children in the current study were younger (age range: 23 - 25 months) than those in the reference group of Herzmann et al. (24 - 29 months). Second, the subject group in the current study included more children (n = 48) than those in the Herzmann et al. study (n = 19). Third, in the current study parents often stated that they had difficulties in answering the questions. With respect to these inconsistencies, it is emphasized that in the absence of tests in German for 2-year-olds the TOMI questionnaire was the most suitable one to control for children's social cognition.

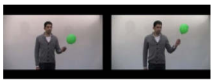
8.1.3 Experimental design

Every child participated in a learning and memory experiment that consisted of six video trials each depicting six different action scenes. The trials were presented in one of two random orders, balanced across conditions and experiments.

Children were randomly assigned to one of two conditions. In all conditions children were presented with the exact same action scenes. The only varying input across conditions were the auditory stimuli as well as the emotional facial expressions of the actors involved. In one condition children were learning novel verbs while the presented actions involved actors with neutral facial expressions (verb neutral condition). In the second condition children were learning verbs while watching actors displaying negative facial expressions (verb negative condition).

The design of the learning test was identical to the one in Study 1, whereas the memory test was modified. That is, first, the reminder question preceding the test phase was excluded. Second, children were presented with two action scenes simultaneously that were identical with regard to the involved actor, object, and action, but varied in the emotional facial expression of the actor. For instance, children were watching a man with an angry facial expression waving a balloon at one side of the screen and the same actor with a neutral facial expression waving an identical balloon at the other side of the screen (see Table 8-1). One of the two facial expressions was an already familiar expression for children, because they had viewed this facial expression while learning the verb. The other facial expression was novel to children and represented the facial expression children in the opposite condition were familiarized with. Thus, for children in the negative condition the actor's neutral facial expression was the novel expression, while the negative expression was familiar to these children. The reverse was true for children in the neutral condition.

Tab. 8-1: Study 2. Example of one trial presented in the memory experiment

	Test			
	baseline		**response**	
visual stimuli				
facial expression	neutral face	angry face	neutral face	angry face
auditory stimuli	Guck mal da! *Look at this!*		Wo telpt der Mann den Ballon? *Where is the man telping the balloon?*	

8.1.4 Apparatus and Procedure

The procedure of the learning and memory experiment was identical to Study 1 except that all children were tested employing a TOBII 1750 eye-tracker.

8.1.5 Dependent Variables

Based on the looking data, different within-subject measures were created for later analysis. Similar to Study 1, each measure for analyzing children's learning and memory performance was created by cutting out a baseline and response window from the test phase. The baseline window was consistent with the last three seconds of the baseline period. The response window started with the onset of the pseudo-verb presented in the test question (e.g. *Where is the man telping the balloon?*) and ended three seconds later.

a) Proportion of looks toward the familiar test scene

Within each window, for each child and each trial the mean proportion of looks toward the familiar test scene was calculated (total number of looks devoted to the familiar test scene, divided by the total number of looks toward both the familiar and novel test scene).

b) Switches of attention between familiar and novel test scene

Within each window, for each child and each trial the mean number of switches between the familiar and novel test scene was calculated.

To analyze children's attention to the action events and the intrinsic input property (i.e., the actor's facial expression) in the learning experiment, three measures were created. One measure consisted of the familiarization phase of the learning test. The remaining two measures were created by cutting out a baseline and response window from the test phase. Starting and end point of both windows were identical to the preceding ones. To analyze children's attention during the memory experiment, only baseline and response window were generated.

c) Attention to the action event

Within each window and the familiarization phase, for each child and each trial the mean number of fixations, the mean length of the longest fixation, and the mean duration of fixations was calculated. Fixations were determined using a dispersion-based algorithm: gazes within a 30 pixel radius and a minimum duration of 100 ms were classified as one fixation.

d) Attention to the actor's facial expression (intrinsic input property)

To examine children's looking toward the actor's facial expression, three types of measures were created:

Measure 1: Within the familiarization phase, for each child and each trial the mean proportion of looks toward the actor's facial expression was computed (total number of looks devoted to the actor's facial expression, divided by the total number of looks toward the entire action scene). Within each window, for each child and each trial the mean proportion of looks toward the actor's facial expression in the novel and familiar test scene was calculated (total number of looks devoted to the actor's face in the familiar and novel test scene, divided by the total number of looks toward both the entire familiar and novel test scene). To compare the baseline and response window with the familiarization phase, the two windows were averaged to create a ‘test phase’ measure.

Measure 2: Within each window, for each child and each trial the mean proportion of looks toward the familiar facial expression of the actor was computed (total number of looks devoted to the actor’s facial expression in the familiar test scene, divided by the total number of looks toward the actor’s facial expression in both the familiar and novel test scene).

Measure 3: Within each window, for each child and each trial the mean proportion of looks toward the familiar facial expression in comparison to the entire familiar test scene was calculated (total number of looks devoted to the actor’s facial expression of the familiar test scene, divided by the total number of looks toward the entire familiar test scene).

8.1.6 Predictions

8.1.6.1 Learning experiment: familiarization phase

It was analyzed whether children individually vary in their attention to the actor’s facial expression while learning the verbs.

8.1.6.1.1 Influence of the emotional input property

The verb negative group should show increased attention to the displayed action scenes and focus more frequently on the actor’s facial expression than the verb neutral group.

8.1.6.2 Learning test: baseline and response window

If children are able to recognize the familiar verb successfully, children in both conditions should look longer at the familiar test scene during the response than during the baseline window.

8.1.6.2.1 Influence of the emotional input property

According to the results of Study 1, the different emotional valence of the actor's facial expression should elicit an interaction effect again. In particular, children in the verb negative condition should show a stronger novelty effect during baseline and a stronger preference for the familiar test scene in the response window than those in the verb neutral condition. Additionally, the verb negative group should show increased attention to the displayed action scenes and focus more frequently on the actor's facial expression than the verb neutral group.

8.1.6.3 Memory test: baseline and response window

With respect to the assumption that the actor's facial expression influences children's verb meaning formation, children should show the following performance: During the baseline window both groups should look more frequently at the scene depicting the novel facial expression. In the response window, both groups should shift their attention toward the scene that displays the actor's facial expression they were viewing while learning the verb. Moreover, the individually varying attention between children to the actor's facial expression while learning the verb might cause individual variability in children's verb interpretation during the response window.

8.1.6.3.1 Influence of the emotional input property

If the actor's neutral facial expression captures less the verb neutral group's attention while verb learning and leaves their verb meaning formation unaffected, they will not show a shift toward the familiar scene during the response window. Similar effects are not expected for the verb negative group.

8.2 Results of Study 2

8.2.1 Inclusion criterion

Only those children were considered for analysis who met the following two criteria: (a) they completed all six test trials and (b) their performance in the looking task was successfully tracked over 60% of the time for at least four trials.

8.2.2 Results of the learning test

Similar to Study 1, two-way analyses of variance (ANOVA) were conducted for each dependent variable, with condition (verb neutral, verb negative) as a between-subject factor and window (baseline, response) as a within-subject factor. For the analysis of children's attention to the action events and the actor's facial expression, the within-subject factor 'window' considered three levels, the familiarization phase, baseline, and response window.

8.2.2.1 Analyses of the learning performance

8.2.2.1.1 Proportion of looks toward the familiar test scene

The two-way ANOVA revealed a main effect for window [$F(1, 46) = 29.90$, $p < .001$, $\eta^2 = .39$], but no effect for condition [$F(1, 46) = 0.59$, ns]. The expected window x condition interaction was also not found [$F(1, 46) = 0.33$, ns]. Thus, children in both conditions performed comparably and looked more frequently toward the familiar test scene during response than during baseline indicating a reliable learning effect (see Figure 8-1).

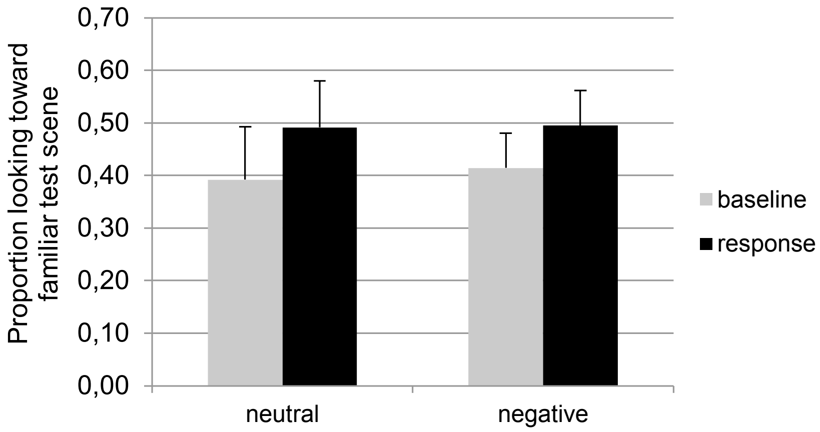


Fig. 8-1: Study 2. Mean proportion of looks toward the familiar scene in the learning test, expressed as a function of condition

8.2.2.1.2 Item analysis

To examine whether the learning effect in both groups was consistent across all six test trials, an item analysis was conducted. The analysis revealed no significant differences [$t(5) = 0.57$, ns]. Thus, children in both groups exhibited consistent learning across all trials.

8.2.2.1.3 Switches of attention between the familiar and novel test scene

The ANOVA revealed a main effect for window [$F(1, 46) = 6.57$, $p < .05$, $\eta^2 = .13$], but no effect for condition and no window x condition interaction (both F's ≤ 0.90, ns). That is, children in both conditions did not differ in their performance and switched their attention more frequently in the baseline ($M = 2.11$, $SD = 0.48$) than in the response window ($M = 1.92$, $SD = 0.57$).

8.2.2.2 Analyses of the attention parameters

8.2.2.2.1 Attention to the action event

Since the data for children's visual attention were not normally distributed, significant results of the parametric analyses were validated by non-parametric tests.

As shown in Table 8-2, children in both conditions fixated the presented stimuli much longer and more frequently in the familiarization than in the test phase (baseline, response). Therefore, differences between groups in the familiarization phase were analyzed separately from the test phase. To examine children's visual attention in the familiarization phase, t-tests for each measure of attention (longest fixation, mean duration of fixation, and number of fixations) were conducted. The t-tests indicated no differences between conditions, i.e., both groups fixated the stimuli comparably in the familiarization phase (all t's ≤ 0.66, ns).

Subsequently, the test phase was analyzed with the baseline and response window as within-subject factor. The analyses revealed only for children's number of fixations a significant main effect of window [$F(1, 46) = 4.14$, $p < .05$, $\eta^2 = .08$], which was confirmed by a marginally significant non-parametric Wilcoxon test ($Z = -1.94$, $p = .05$, $r = -.20$). Thus, children in both conditions demonstrated marginally more frequent fixations in the response than in the baseline window. Apart from that, the ANOVAs yielded no effects for condition and no window x condition interactions (all F's ≤ 1.48, ns). These results indicate that children in the verb negative condition did not pay more attention to the action events than children in the verb neutral condition.

Tab. 8-2: Study 2. Means for measures of attention for each condition in the learning test

		neutral		**negative**	
		Mean	SD	Mean	SD
Number of fixations	familiarization	42.00	15.23	44.43	14.18
	baseline	4.95	2.10	5.47	1.94
	response	5.31	1.97	5.63	1.98
Duration of fixations (ms)	familiarization	411.11	184.20	378.36	160.34
	baseline	375.94	211.62	304.31	131.11
	response	369.72	183.72	326.19	142.82
Longest fixation (ms)	familiarization	1527.99	761.34	1649.40	770.74
	baseline	706.06	372.96	630.26	303.31
	response	744.69	415.31	690.79	319.58

8.2.2.2.2 Attention to the actor's facial expression

Analysis of ***Measure 1****:* A first two-way ANOVA compared children's looking toward the actor's facial expression between the familiarization and test phase. The analysis revealed a main effect for window [$F(1, 46) = 28.42$, $p < .001$, $\eta^2 = .38$] and a main effect for condition [$F(1, 46) = 5.01$, $p < .05$, $\eta^2 = .10$], but no window x condition interaction [$F(1, 46) = 1.50$, ns]. That is, children in both conditions looked more frequently at the actor's face in the test phase ($M = 0.26$, $SD = 0.15$) than in the familiarization phase ($M = 0.21$, $SD = 0.11$). However, children in the verb neutral group fixated the actor's face significantly more frequently ($M = 0.28$, $SD = 0.12$) than children in the verb negative condition ($M = 0.20$, $SD = 0.12$).

Analysis of ***Measure 2****:* A second ANOVA compared children's fixations on the actor's familiar facial expression during the baseline and response window. The analysis indicated a main effect for window [$F(1, 46) = 28.00$, $p < .001$, $\eta^2 = .38$], but no main effect for condition [$F(1, 46) = 2.01$, ns]. That is, children in both groups performed comparably and looked more frequently at the actor's familiar facial expression during the response ($M = 0.40$, $SD = 0.19$) than during the baseline window ($M = 0.27$, $SD = 0.16$). Furthermore, a window x condition interaction was revealed [$F(1, 46) = 45.27$, $p < .05$, $\eta^2 = .10$]. Post-hoc tests were performed comparing children's looking between conditions in each window. The tests indicated no significant differences during the baseline window [$t(46) = 0.14$, ns], but significantly more attention toward the familiar facial expression of the verb neutral ($M = 0.45$, $SD = 0.18$) than the verb negative group ($M = 0.34$, $SD = 0.18$) during the response window [$t(46) = 2.23$, $p < .05$, $d = 0.64$].

Analysis of ***Measure 3****:* A third analysis examined whether the greater proportion of looking during the response window either was caused by children's heightened interest for the facial expression or resulted from their interest for the entire test scene, which automatically raised the chance to randomly hit the facial expression. To this end, the third ANOVA compared children's looking toward the familiar facial expression in proportion to their looking toward the entire familiar test scene in the baseline and response window. It was expected that the proportion of looking toward the facial expression during response would be greater than during the baseline window if children take into account the actor's facial expression to decide which action scene corresponds to the familiar verb. The ANOVA supported this assumption only for the verb neutral group (see Figure 8-2) showing a main effect for window [$F(1, 46) = 4.13$, $p < .05$, $\eta^2 = .08$] and a marginal effect for condition [$F(1, 46) = 3.55$, $p < .07$, $\eta^2 = .07$] qualified by a window x condition interaction [$F(1, 46) = 4.57$, $p < .05$, $\eta^2 = .09$]. Subsequent pairwise t-tests indicated that children in the verb neutral condition looked significantly more frequently toward the facial expression during response than during baseline window [$t(23) = 2.74$, $p < .01$, $d = 0.38$], whereas the verb negative group looked equally frequently at the actor's face in both windows [$t(23) = 0.08$, ns].

Taken together, the verb neutral group compared to the verb negative group looked significantly more frequently at the actor's familiar facial expression across the entire learning trial and exhibited a significantly greater proportion of looks toward the actor's familiar facial expression when asked to recognize the familiarized verb (response window).

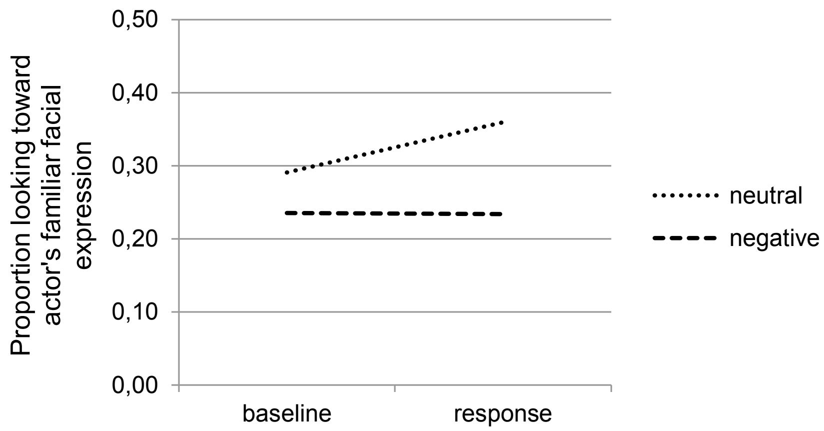


Fig. 8-2: Study 2. Mean proportion of looking toward the actor's familiar facial expression in proportion to the entire scene during the learning test, expressed as a function of condition

8.2.2.3 Analyses based on children's facial preferences

In order to analyze the assumption that children individually vary in their preference to fixate the actor's facial expression during verb learning, each condition (neutral, negative) was split into two different 'facial preference groups'. Both groups were equal in the number of subjects. Employing children's proportion of looks toward the actor's facial expression in the familiarization phase, children whose looking proportion fell below the median were considered as 'facial preference-low' lookers (n = 24) and those whose looking proportion fell above the median as 'facial preference-high' lookers (n = 24). By a subsequent t-test it was analyzed whether the created groups differ reliably in their looking toward the actor's facial expression. The test demonstrated significant differences [$t(46) = -8.46$, $p < .001$, $d = 2.44$].

In a next step, it was examined whether children's preference for the actor's face correlated with their age, sex, language competence (receptive, productive), and social cognition (TOMI) scores. Children's preference for the actor's face only correlated with their language production competence ($r_s = .38$, $p < .05$). The correlation indicated that children in the facial preference-high group had greater language production competences ($M = 59.71$ words, $SD = 27.85$) than children from the facial preference-low group ($M = 42.41$ words, $SD = 27.99$) as validated by a t-test ($t(44) = -2.10$, $p < .05$, $d = 0.62$). A subsequent semi-partial correlation tested whether the correlation persists even if children's language production is controlled for their age. This seemed necessary, since a medium correlation was found between children's language production scores and their age ($r_s = .34$, $p < .05$). The semi-partial correlation yielded that independently of age children's facial preferences correlated with their language production competence ($sr = .30$, $p < .05$).

To investigate whether the intensity of looking toward the facial expression in correlation with children's language competence affected verb learning in both groups differently, two-way ANOVAs with 'window' as the within-subject factor and 'facial preference' (high, low) as the between-subject factor were conducted. The following parameters were compared between the two facial preference groups: (a) attention, (b) the proportion of looks toward the familiar test scene, and (c) the switches of attention.

8.2.2.3.1 Proportion of looks toward the familiar test scene

The two-way ANOVA revealed a main effect for window [$F(1, 46) = 29.89$, $p < .001$, $\eta^2 = .39$], but no effect for facial preference and no window x facial preference interaction (both F's ≤ 0.31, ns).

Thus, the performance between groups did not differ and children in both conditions looked equally more frequently at the familiar test scene in the response than the baseline window (see Figure 8-3). This suggests a learning effect in both groups.

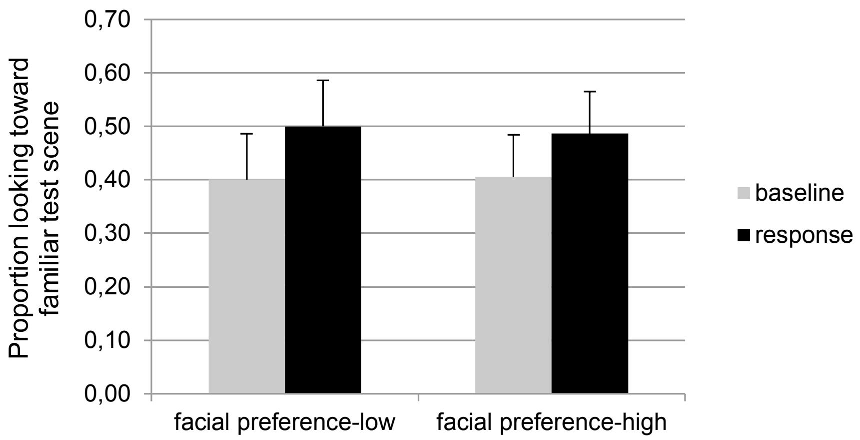


Fig. 8-3: Study 2. Mean proportion of looks toward the familiar scene in the learning test, expressed as a function of facial preference group

Furthermore, a fine-grained analysis in terms of dividing the response window into smaller bins (each 300 ms in duration) indicated that children of both groups displayed heightened attention to the familiar test scene (see Figure 8-4), especially within the time frame the test question was presented (between bin1 and bin5). This performance was comparable between groups as analyses by t-tests revealed (all *t*'s ≤ 1.06, ns).

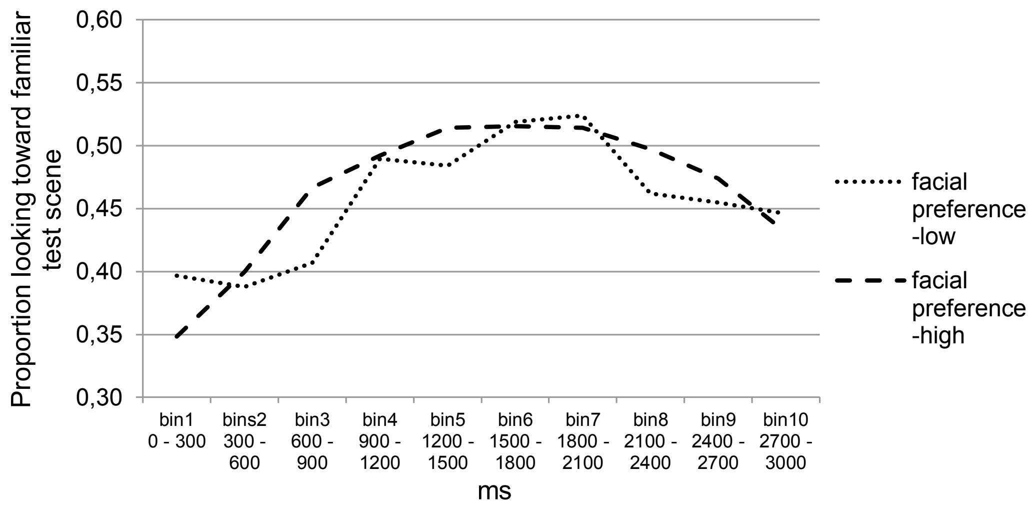


Fig. 8-4: Study 2. Time-course of children's looking behavior in the response window of the learning test, aggregated over all trials and expressed as a function of facial preference group

8.2.2.3.2 Switches of attention between the familiar and novel test scene

The two-way ANOVA indicated no effect for facial preference [$F(1, 46) = 0.33$, ns], i.e., children in both groups switched their attention comparably. However, there was a main effect for window [$F(1, 46) = 7.05$, $p < .05$, $\eta^2 = .13$], which was qualified by a window x 'facial preference' interaction [$F(1, 46) = 4.30$, $p < .05$, $\eta^2 = .09$]. Post-hoc tests were performed to analyze the switching pattern between conditions during baseline and response window. These analyses revealed that children in the facial preference-low group switched significantly less frequently than the facial preference-high group during the baseline window [$t(46) = -1.68$, $p < .05$, $d = 0.49$], whereas both groups performed comparably in the response window [$t(46) = 0.46$, ns; see Figure 8-5). Thus, both groups became more focused on one test scene from baseline to response window, albeit the 'facial expression-high' group compared more frequently between novel and familiar information in the baseline window.

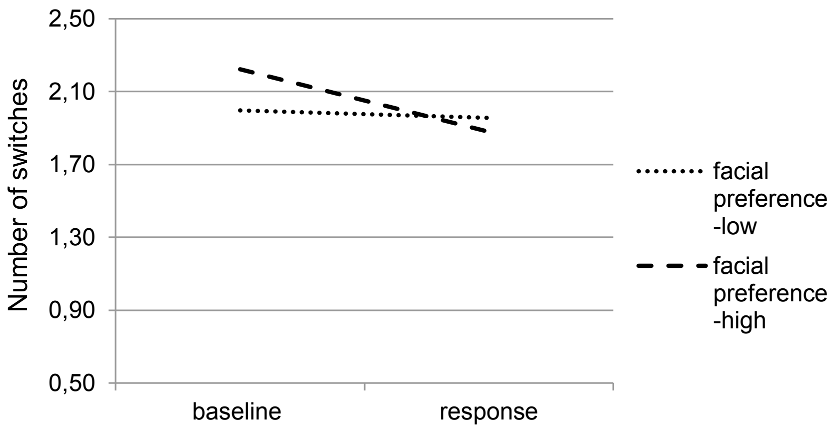


Fig. 8-5: Study 2. Mean number of switches in the learning test, expressed as a function of facial preference group

8.2.2.3.3 Attention to the action event

Since the data for children's visual attention were not normally distributed, significant results of the parametric analyses were validated by non-parametric tests.

As shown in Table 8-3, children in both conditions fixated the presented stimuli much longer and more frequently in the familiarization than in the test phase (baseline, response). Therefore, differences between groups in the familiarization phase were analyzed separately from the test phase. To examine children's visual attention in the familiarization phase, t-tests for each measure of attention (longest fixation, mean duration of fixation, and number of fixations) were conducted. The t-tests indicated no differences between conditions, i.e., both groups fixated the stimuli comparably in the familiarization phase (all t's $\leq$ -1.29, ns).

For the test phase involving the baseline and response window as the within-subject factor, each measure of attention was analyzed in a two-way ANOVA. For children's number of fixations the analyses yielded a main effect of window [$F(1, 46) = 4.50$, $p < .05$, $\eta^2 = .09$] as well as a window x facial preference interaction [$F(1, 46) = 4.73$, $p < .05$, $\eta^2 = .09$], but no main effect for facial preference [$F(1, 46) = 2.01$, ns]. Post-hoc tests revealed, on the one hand, that children in the facial preference-high group fixated more frequently in the baseline window than children in the facial preference-low group [$t(46) = -1.85$, $p < .05$, $d = 0.53$]. On the other hand, the facial-preference-high group performed comparably between baseline and response window, while the number of fixations significantly increased from baseline to response in the facial preference-low group [$t(23) = 2.87$, $p < .01$, $d = 0.26$]. Analyses by non-parametric tests supported this finding revealing significantly more fixations in the facial preference-high than preference-low group during the baseline window ($U = 189.50$, $Z = -2.03$, $p < .05$, $r = -.29$) and a significant increase of fixations from the baseline to the response window in the facial preference-low group ($Z = -2.33$, $p < .05$, $r = -.34$). The remaining analyses yielded no further main and interaction effects (all F's $\leq$ 2.63, ns).

Tab. 8-3: Study 2. Means for measures of attention for each facial preference group in the learning test

		facial preference-low		**facial preference-high**	
		Mean	SD	Mean	SD
Number of fixations	familiarization	40.90	15.97	45.54	13.04
	baseline	4.69	2.04	5.74	1.89
	response	5.21	2.04	5.73	1.88
Duration of fixations (ms)	familiarization	363.09	170.22	426.39	170.68
	baseline	306.88	166.07	373.37	186.45
	response	311.18	157.87	384.73	165.50
Longest fixation (ms)	familiarization	1448.69	777.53	1728.70	732.06
	baseline	579.99	319.35	756.33	340.41
	response	648.66	357.35	786.83	372.11

8.2.2.4 Interim summary of the learning test

Children in the verb negative and verb neutral group showed a reliable learning effect, which was characterized by devoting more attention to the familiar scene and less attention switching in the response than the baseline window. The attention to the presented action scenes was comparable between groups. Thus, the verb negative group did not show increased attention to the action events. Furthermore, both groups focused more on the actor's face in the test than in the familiarization phase. However, the verb neutral group compared to the negative condition spent more time looking toward the actor's facial expression across the entire learning trial and especially during the response window. Separating children by their preference for the actor's facial expression revealed that children who paid significantly more attention to the actor's face also demonstrated (a) higher language production scores, (b) a higher attentional shift rate during the baseline window, and (c) more frequent fixations on the action events in the baseline window. Nevertheless, both facial preference groups demonstrated verb learning.

8.2.3 Results of the memory test

8.2.3.1 Analyses of the memory performance

8.2.3.1.1 Proportion of looks toward the familiar test scene

The two-way ANOVA yielded no main effects as well as no window x condition interaction (all *F*'s ≤ 1.73, ns). Thus, children in both conditions did not look significantly more frequently toward the familiar test scene during the response than during the baseline window (see Figure 8-6).

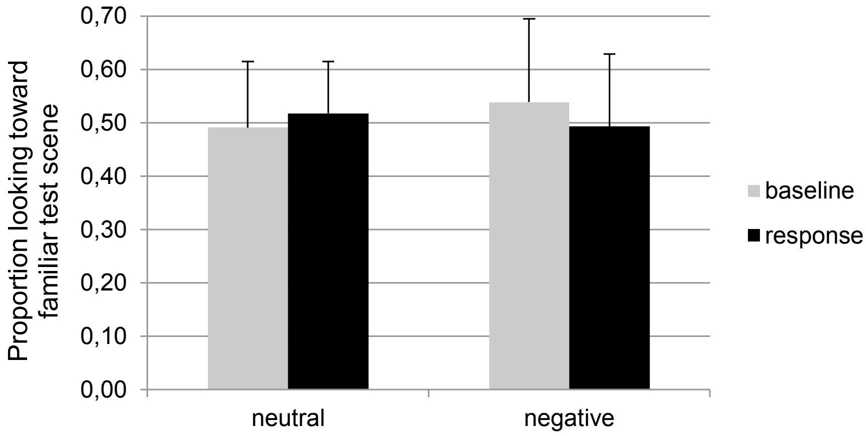


Fig. 8-6: Study 2. Mean proportion of looks toward the familiar scene in the memory test, expressed as a function of condition

8.2.3.1.2 Switches of attention between the familiar and novel test scene

The ANOVA revealed a main effect for window [$F(1, 46) = 18.52$, $p < .001$, $\eta^2 = .29$] and a marginal effect for condition [$F(1, 46) = 3.08$, $p = .09$, $\eta^2 = .06$], qualified by a window x condition interaction [$F(1, 46) = 7.90$, $p < .01$, $\eta^2 = .15$]. Post-hoc tests indicated significantly less switches in the verb neutral than in the verb negative condition during the response window [$t(46) = 2.94$, $p < .01$, $d = 0.85$]. In the baseline window both conditions performed comparably [$t(46) = 0.23$, ns]. Subsequent pairwise t-tests comparing children's switches between baseline and response window in each condition yielded significantly more switches during the baseline than during the response window in the verb neutral condition [$t(23) = 4.33$, $p < .001$, $d = 0.93$], but no effect in the verb negative condition [$t(23) = 1.31$, ns]. Thus, children in the verb neutral condition were more focused on one of the two test scenes during the response window than children in the verb negative condition, who switched attention comparably in the baseline and response window (see Figure 8-7). Since the proportion of looks toward the familiar scene did not significantly differ between both conditions during the response window, it is not possible to argue here that children in the verb neutral condition were reliably more focused on the familiar test scene than children in the verb negative condition.

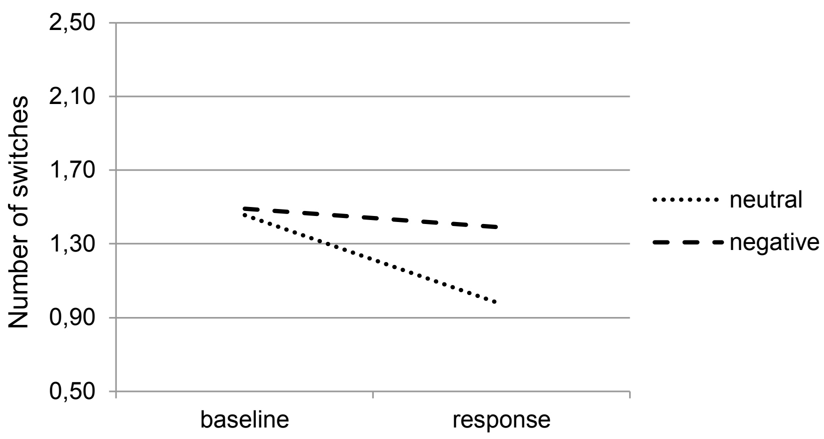


Fig. 8-7: Study 2. Mean number of switches in the memory test, expressed as a function of condition

8.2.3.2 Analyses of the attention parameters

8.2.3.2.1 Attention to the action event

Since the data for children's visual attention were not normally distributed, significant results of the parametric analyses were validated by non-parametric tests.

For each measure of attention a two-way ANOVA was conducted. The analyses revealed a main effect of window for all three measures (all F's ≥ 9.43, all p's $< .001$, all $\eta^2 \geq .17$). Subsequent non-parametric Wilcoxon tests confirmed the results (all Z's ≥ -2.71, all p's $< .01$, all r's $\geq -.28$). Moreover, no main effects for condition and no window x condition interactions were found (all F's ≤ 1.53, ns). Altogether, the analyses indicated that children's attention to the action scenes did not differ between conditions while both groups fixated the test scenes more frequently during the baseline window, but spent longer fixations in the response window (see Table 8-4).

Tab. 8-4: Study 2. Means for measures of attention for each condition in the memory test

		neutral		**negative**	
		Mean	SD	Mean	SD
Number of fixations	baseline	6.00	1.36	5.20	2.03
	response	5.22	1.30	5.01	1.96
Duration of fixations (ms)	baseline	378.43	169.44	374.34	198.80
	response	485.78	256.18	430.77	261.23
Longest fixation (ms)	baseline	704.40	336.91	688.13	363.20
	response	923.11	477.35	830.84	480.18

8.2.3.2.2 Attention to the actor's facial expression

*Analysis of **Measure 2***: A two-way ANOVA comparing children's looking toward the familiar facial expression in the baseline and response window yielded no main effects as well as no window x condition interaction (all F's ≤ 2.50, ns). Thus, children in both conditions looked comparably at the actor's familiar facial expression with no differences in performance during the baseline and response window.

Analysis of ***Measure 3***: Children's looking toward the familiar facial expression in proportion to the entire familiar test scene was compared by a further ANOVA. The analysis indicated a main effect for window [$F(1, 46) = 16.71$, $p < .001$, $\eta^2 = .27$], but no main effect for condition as well as no window x condition interaction (both *F*'s ≤ 0.45, ns). Thus, the looking proportion did not differ between groups while in both conditions the proportion of looks devoted toward the actor's face as compared to the entire test scene was greater in the baseline than in the response window (see Figure 8-8).

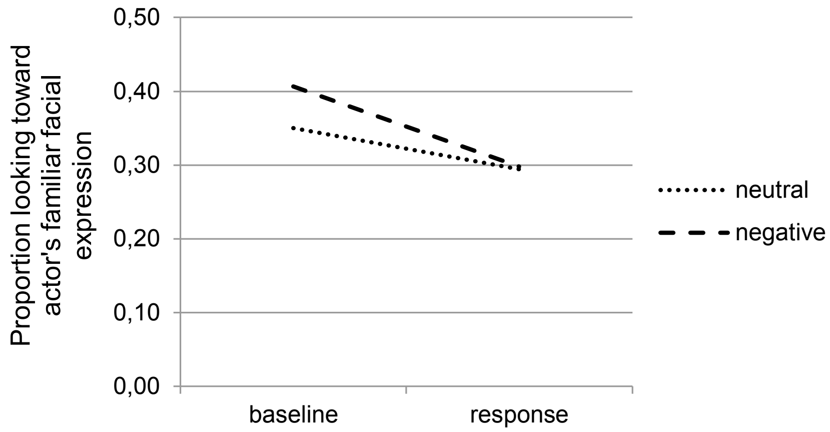


Fig. 8-8: Study 2. Mean proportion of looking toward the actor's familiar facial expression in proportion to the entire scene during the memory test, expressed as a function of condition

8.2.3.3 Analyses based on children's facial preferences

A general aim of the second study was to examine how children's attention to the intrinsic input property, i.e., the actor's facial expression, interacts with their memory performance such that the amount of attention they pay to the actor's face while learning the verb influences their verb interpretation in the memory test. Since the results of the learning experiment indicated that children's individual preferences for the actor's face correlated with differences in language competence and visual attention, it was assumed that the individual preference for the actor's face might also differently affect children's memory performance. In other words, children who demonstrated greater preferences for the facial expression during verb learning might show a different looking behavior during memory compared to those children who looked less frequently at the actor's face. Following this logic, children were grouped again as 'facial preference-high' and 'facial preference-low' based on their proportion of looks toward the actor's face during the familiarization phase of the learning experiment. This way, children belonged to the exact same facial preference group as they did for the analysis of the learning test. It was expected that children of both groups would demonstrate a similar preference for the actor's face during memory as they did during learning. To verify this assumption, it was tested whether children's attention to the actor's face significantly differed between groups during the memory test. The t-test supported the assumption: those children who demonstrated increased attention to the actor's facial expression in the learning experiment fixated the face also more frequently in the memory experiment ($M = 0.41$, $SD = 0.13$) as compared to those children with less interest in the facial expression while learning [$M = 0.29$, $SD = 0.15$; $t(46) = -2.99$, $p < .01$, $d = 0.86$].

In a next step, it was explored if the intensity of looking toward the facial expression affected children's memory for the familiarized verbs differently in both groups. Two-way ANOVAs with 'window' as the within-subject factor and 'facial preference' (high, low) as the between-subject factor were conducted to compare between groups (a) children's attention, (b) the proportions of looks toward the actor's face, and (c) the switches of attention.

8.2.3.3.1 Proportion of looks toward the familiar test scene

The two-way ANOVA yielded no main effects for window and facial preference as well as no window x facial preference interaction (all F's ≤ 0.19, ns). That is, children in both groups demonstrated no differences in their looking behavior and performed comparably between the baseline and response window.

Subsequently, a fine-grained analysis was conducted by dividing the response window into bins (each 300 ms in duration). As displayed in Figure 8-9, the descriptive results revealed differences in the looking pattern between groups. Whereas children from the facial preference-high group looked primarily at the familiar test scene between bin two and six, the facial preference-low group looked primarily toward the novel test scene. From bin seven and the following bins, the looking pattern of both groups reversed into its opposite. Interestingly, during bin two and five the test question was presented, which coincided with the time frame where the looking pattern of both groups differed the most. T-tests were performed for each bin comparing the proportion of looks toward the familiar test scene between the two facial preference groups. The tests, however, revealed no significant effects (all t's ≤ 1.31, ns).

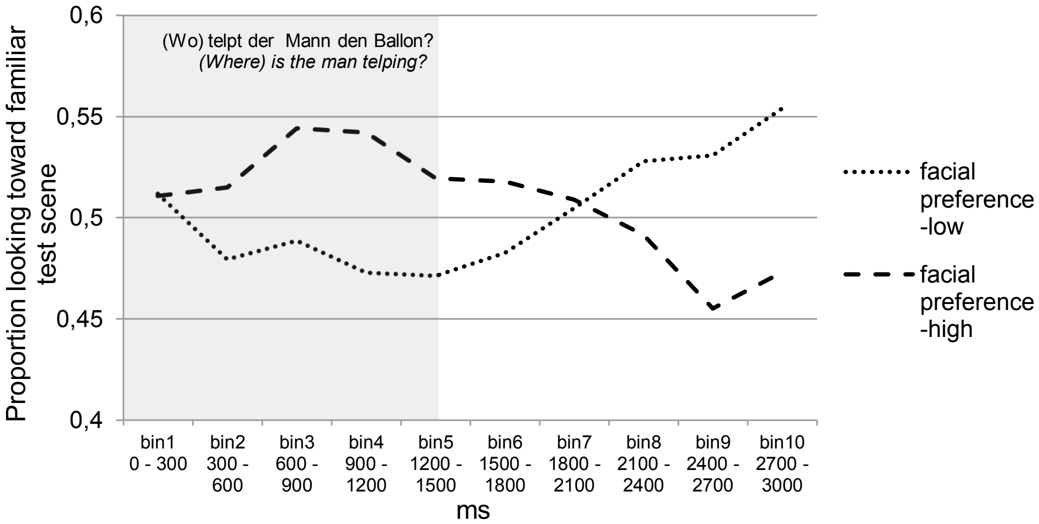


Fig. 8-9: Study 2. Time-course of children's looking behavior in the response window of the memory test, aggregated over all trials and expressed as a function of facial preference

In two subsequent analyses the looking pattern across bins was compared between the two facial preference groups within each condition (neutral, negative). In the verb neutral condition the descriptive results indicated that children from the facial preference-low group devoted a greater proportion of looking toward the familiar test scene than children in the facial preference-high group (see Figure 8-10), albeit t-tests indicated no significant differences (all t's ≤ 1.35, ns). Across all bins children of both groups demonstrated a fairly similar looking pattern; however, in the earlier bins more than in the following ones, which might be explained by the presentation of the test question, which prompted children to shift their attention toward the familiar test scene.

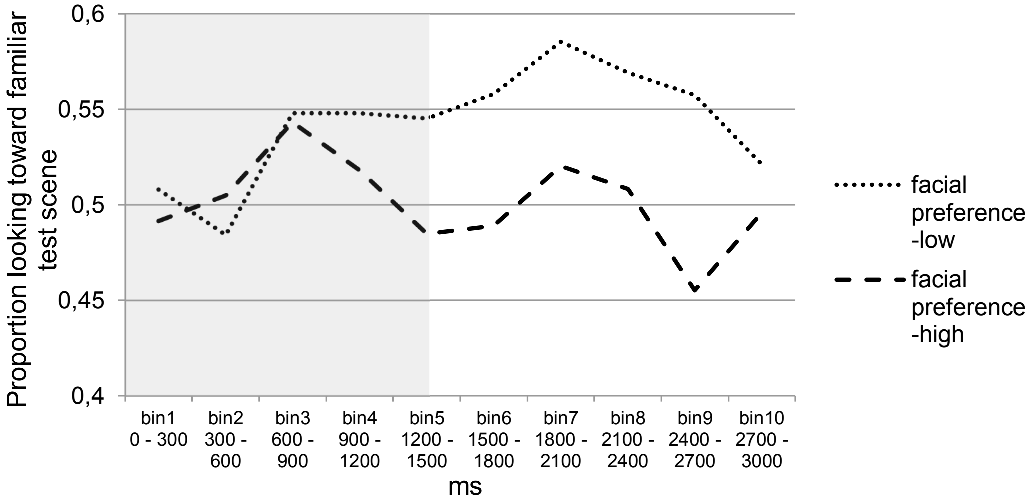


Fig. 8-10: Study 2. Time-course of children's looking behavior in the neutral condition in the response window of the memory test, aggregated over all trials and expressed as a function of facial preference

In the verb negative condition the facial preference-high group looked much more frequently toward the familiar test scene than the facial preference-low group, especially during bin two till five, which coincided with the presentation of the test question (see Figure 8-11). This difference manifested in a significantly greater proportion of looking toward the familiar test scene in the facial preference-high group than the facial preference-low group during bin four [$t(22) = -2.09$, $p < .05$, $d = 0.84$].

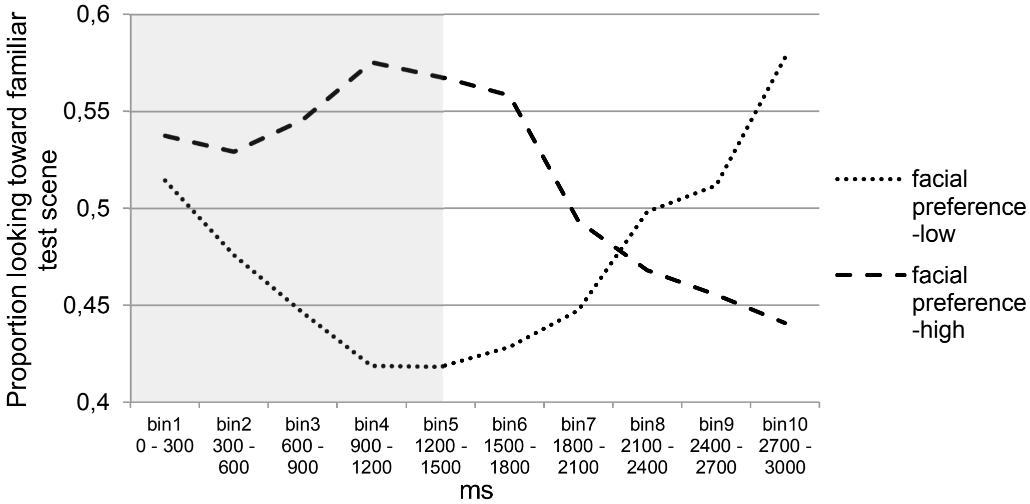


Fig. 8-11: Study 2. Time-course of children's looking behavior in the negative condition in the response window of the memory test, aggregated over all trials and expressed as a function of facial preference

8.2.3.3.2 Switches of attention between the familiar and novel test scene

The two-way ANOVA revealed a main effect for window [$F(1, 46) = 15.81$, $p < .001$, $\eta^2 = .26$], but no main effect for facial preference and no window x facial preference interaction [both F's ≤ 0.01, ns]. Thus, both groups did not differ in their switches of attention, but they switched their attention equally more frequently in the baseline ($M = 1.47$, $SD = 0.51$) than in the response window ($M = 1.18$, $SD = 0.53$).

8.2.3.3.3 Attention to the action event

Since the data for children's visual attention were not normally distributed, significant results of the parametric analyses were validated by non-parametric tests.

For each measure of attention the two-way ANOVA's yielded a main effect for window (all F's > 9.04, all p's $< .01$, all $\eta^2 > .16$) indicating longer fixations during response and more frequent fixations for both groups in the baseline window (see Table 8-5). Analyses by non-parametric Wilcoxon tests supported these findings (all Z's ≥ -2.71, all p's $< .01$, all r's $\geq -.28$). Apart from that, the ANOVAs revealed no main effects for facial preference and no window x facial preference interactions (all F's ≤ 1.53, ns). Thus, children performed comparably in both groups.

Tab. 8-5: Study 2. Means for measures of attention for each facial preference group in the memory test

		facial preference-low		**facial preference-high**	
		Mean	SD	Mean	SD
Number of fixations	baseline	5.35	1.33	5.85	2.10
	response	5.06	1.20	5.17	2.02
Duration of fixations (ms)	baseline	372.66	171.06	380.11	197.37
	response	474.57	248.47	441.98	270.47
Longest fixation (ms)	baseline	676.19	311.65	716.35	384.18
	response	927.58	461.76	826.37	494.28

8.2.3.4 Interim summary of the memory test

The looking performance of the verb negative and verb neutral group indicated no evidence for a memory effect. In contrast to the negative condition, children in the verb neutral group demonstrated a decrease in their attentional shift rate from baseline to response window. Both groups attended comparably to the action events and fixated the actors facial expression equally more frequently in the baseline than in the response window. Moreover, children's preference for the actor's facial expression represented an individually consistent variable, i.e., children demonstrating heightened attention to the actor's face in the learning experiment were also more focused on the actor's face during the memory test than children with less interest in the facial information. Both facial preference groups performed comparably across the test phase indicating no memory effect, a similar pattern of attention, and equal rates of attention switching. Only the descriptive results of the fine-grained analyses suggested differences in children's looking performance during the response window. Here, children from the facial preference-high group shifted more frequently toward the familiar test scene and the facial preference-low group toward the novel scene. An analysis by condition (negative, neutral) revealed that this difference in looking performance between both facial preference groups appeared in the negative condition, but not in the neutral one.

8.2.4 Summary of the results of Study 2

The aim of the second experiment was to explore (a) whether the intrinsic emotional input property affects the content of novel verbs that are learned, i.e., the verbs' meaning, and (b) whether the influence of the intrinsic input property on children's verb meaning formation is determined by the attention children pay to the intrinsic input property while verb learning. To this end, it was investigated, first, whether the intrinsic input property (i.e., the actor's facial expression) influenced children's verb encoding processes. Second, whether the intrinsic emotional input property affects the content of the novel verbs that are learned, i.e., the verbs' meaning. Third, whether children's attention to the presented action events and the intrinsic input property varies as a function of emotional valence (neutral vs. negative). Fourth, whether the amount of attention children pay individually to the intrinsic input property while learning the verb influences their verb interpretation in the memory test.

8.2.4.1 Learning test

Results for condition (neutral, negative). First of all, the expected interaction indicating enhanced learning in the verb negative group was not found in the second experiment. Instead, in both conditions children demonstrated a significant learning effect, which was qualified by less switches as well as longer and more frequent fixations in the response (presenting the familiar verb) than the baseline window. This pattern of attention was comparable between conditions. Thus, the negative emotional valence of the intrinsic input property did not increase children's attention to the presented action events as it was expected. With regard to children's interest in the actor's facial expression, results indicated that children of both groups focused on the intrinsic input property more frequently in the test than in the familiarization phase. This suggests that they considered the actor's facial expression more frequently when distinguishing novel from familiar information. However, in contrast to the prediction, the verb neutral condition was generally more interested in the actor's facial expression than the verb negative condition and considered the facial expression specifically for verb retrieval when asked to recognize the familiar verb (response window). A similar reaction during the response window was not found for the verb negative group.

Results for facial preference (high, low). Another finding was that children varied in their attention to the displayed facial expressions, which correlated with their language production competence. In particular, children with higher language scores paid more attention to the actor's facial expression than children with lower scores. This correlation was found in the verb neutral and negative condition. Further analyses revealed that children's attention to the facial expression was a stable factor across the familiarization and test phase, i.e., children who focused frequently on the actor's facial expression during the familiarization phase also exhibited significantly more attention to the familiar facial expression at test as compared to children who demonstrated less interest. The results for children’s visual attention echoed the difference between the facial preference groups. Children in the facial preference-high group fixated the action events more frequently and demonstrated increased attention switching in the baseline window compared to the preference-low group. This suggests that the facial preference-high group better distinguished novel from familiar information suggesting enhanced recognition memory. Additionally, the descriptive results indicated a trend to longer and more frequent fixations across the familiarization and test phase in the facial preference-high group, which may indicate enhanced attention and processing of the presented stimuli. However, this inference needs to be treated with great caution, because the descriptive results were not supported by the statistical analyses.

8.2.4.2 Memory test

Results for condition (neutral, negative). Unlike the prediction, children in both conditions did not show a novelty effect for the displayed novel facial expression in the baseline window as well as no preference for the familiar facial expression in the response window. Instead, children in both conditions looked more frequently toward the familiar facial expression in proportion to the entire action scene during the baseline than during the response window. This suggests that they detected and remembered the familiar facial expression, which they intensively compared with the displayed novel facial expression as the number of switches during the baseline window implies. This interpretation is in accord with the results on children’s visual attention, which indicated more frequent fixations in the baseline window, but longer fixations in the response window. It suggests that the presentation of the familiar verb caused children to maintain their attention longer to specific aspects of the presented action scenes in the latter window. Taken together, the analysis suggests that children in both conditions remembered the facial expression from the learning experiment. However, the internal state message conveyed by the different emotional valence of the actor’s facial expression does not seem to have influenced their verb meaning formation.

Results for facial preference (high, low). The analysis by facial preference groups might have revealed more insights regarding the formulated predictions. First, it was found that children maintained their level of interest for the actor's facial expression across the learning and memory test, i.e., children who focused more frequently on the actor's face during learning looked also more frequently at the actor's face during memory compared to children who neglected the actor's facial expression in the learning test. Second, the more fine-grained analysis of the response window indicated that children in the facial preference-high group shifted their attention more frequently toward the familiar test scene when the familiarized verb was presented, whereas children in the facial preference-low group shifted more frequently toward the novel facial expression. However, this difference in attention shifting was evident in the descriptive results and not confirmed by the statistical analysis. It is noteworthy, though, that for the learning test a similar difference between groups was not indicated by the descriptive results, i.e., children in both groups shifted equally toward the familiar test scene in the critical time window presenting the test question. Third, the analysis by facial preference and emotion condition (neutral, negative) indicated that in the neutral condition both facial preference groups displayed a similar pattern by looking more toward the familiar than novel test scene during the presentation of the familiarized verb. This might be explained in terms of their significantly increased attention to the actor's facial expression during the learning experiment. In contrast to the neutral condition, the looking pattern in the negative condition clearly differed between groups. That is, children from the facial preference-high group looked more frequently at the familiar test scene than children in the facial preference-low group, which manifested in a significant difference right before the end of the test question. In sum, the analysis by facial preference groups, especially the fine-grained analysis of the response window in the memory test, may indicate that the influence of the intrinsic input property on children's verb meaning formation was an individually varying process, which interacted with the emotional valence of the input property and children's language competences. This conclusion is drawn extremely cautiously, since the descriptive results on children's memory performance were only marginally supported by the statistical analyses.

8.3 Discussion

8.3.1 No enhancing influence of the negative input property on children's learning performance

In contrast to Study 1, the verb negative group showed no enhanced learning effect reflected by an increased novelty preference during baseline and a stronger preference for the familiar item during the response window. The differences in performance between the verb negative groups in Study 1 and 2 might be ascribed to differences in children's developmental state of social cognition, which was assessed by the parental questionnaire TOMI. Whereas children of Study 1 demonstrated a competence comparable to the one showed by the sample in Herzmann et al., children's competence in Study 2 was evaluated more than one standard deviation below the mean of the sample in Herzmann et al. (see section 8.1.1). Further analyses revealed that children in the verb negative group of Study 1 had significantly higher scores than those of Study 2 [$t(41) = -3.27$, $p < .01$, $d = 1.00$]. These results need to be interpreted with some caution, because it is not assessable how accurate parents estimated their children's competences in Study 2. As mentioned earlier, adults in Study 2 often stated difficulties in answering the questionnaire (see footnote 10 section 8.1.1).

However, if we assume that the parental judgments nearly reflect the children's current developmental state of social cognition, children's lower competence in Study 2 may have caused that they detected and recognized the intrinsic emotional input property more slowly than children in Study 1. The decreased processing of the intrinsic emotional input cue, in turn, may have contributed to the fact that no enhancing effect on verb encoding was found. A direct comparison of children's attention to the emotional input cue (i.e., the actor's facial expression) in Study 1 and 2 might have helped to resolve whether differences in attention to and processing of the emotional input cue resulted in the different effects on verb learning. However, such a comparison was not possible, because a different experimental apparatus (video camera recordings vs. eye-tracker) was employed in the two studies. Instead, a sub-group of children in the negative condition of Study 2 was created (n = 10), whose TOMI scores (*M* = 10.10, *SD* = 1.56) matched the scores of the negative group in Study 1 [*M* = 11.00, *SD* = 3.43, *U* = 82.00, *Z* = -1.14, ns]. Subsequently, it was analyzed whether this sub-group showed a trend for enhanced learning similar to the effect that was found in Study 1. The learning performance of the negative sub-group was compared with the learning exhibited by a sub-group of children in the neutral condition of Study 2 (n = 10). The TOMI scores of this neutral sub-group (*M* = 10.93, *SD* = 2.23), likewise, matched the scores of children in the neutral condition of Study 1 [*M* = 11.33, *SD* = 3.51, *U* = 84.00, *Z* = -0.70, ns]. It was found that the negative sub-group demonstrated a significant learning effect [$t(9) = -3.87$, $p < .01$, $d = 1.60$], while learning in the neutral condition did not reach significance [$t(9) = -1.63$, ns]. This was confirmed by non-parametric tests indicating that more children in the negative sub-group displayed learning than expected by chance [9 out of 10, $\chi^2(1) = 6.40$, $p < .05$], while the number of children in the neutral condition did not differ from chance [7 out of 10, $\chi^2(1) = 1.60$, ns]. Thus, when children in the negative group in Study 2 demonstrated a similar developmental state of social cognition as compared to those in Study 1, the intrinsic emotional input property seems to have a similarly enhancing effect on their verb learning. This result supports the assumption that the missing influence of the emotional input property on children's verb learning performance in Study 2 may be ascribed to their lower levels of social cognition. Nevertheless, this assumption remains subject to speculation unless further investigations including children with socio-cognitive abilities that match those in Study 1 are conducted.

Moreover, the screen on which the action events were presented might have also played some role for the different results in Study 1 and 2. In Study 1 children viewed the action scenes on a 42" flat screen, whereas in Study 2 the screen of the eye-tracker was smaller (17"). Thus, the displayed facial expressions in Study 1 might have been easier to perceive than in Study 2. This might have caused that children in Study 2 required more time and attention deployment to recognize the emotional expression, which in turn led to differences in integrating the emotional input property in the verb encoding process. Hence, further experiments should consider this issue.

8.3.2 No constraining effect of the negative input property on children's verb meaning formation

If the intrinsic emotional information affected children's verb meaning formation, it was expected to find a preference for the action scene that displayed the actor's facial expression children watched while learning the novel verb. However, this effect was not found. Instead, children in both conditions performed comparably in the baseline and response window by demonstrating no preference for the action scene with the familiarized emotional information when asked to remember the familiarized verb (response window). This result is called the null-preference.

Null-preferences were already observed in other studies testing infants' non-verbal memory (Bahrick, Hernandez-Reif, & Pickens, 1997; Bahrick & Pickens, 1995). Studies examining infants' memory by using different tasks in parallel (e.g. mobile conjugate reinforcement task and looking preference procedure) demonstrated that children remembered the learned information, although they exhibited null-preferences in the VPC (visual paired comparison, see Chapter 6; Gross, Hayne, Herbert, & Sowerby, 2002; Wilk, Klein, & Rovee-Collier, 2001). Thus, a null-preference in the VPC does not automatically reflect memory loss. By interpreting novelty, null, and familiarity preferences as measures for infants' memory performance, Bahrick and Pickens (1995) proposed a four-phase model representing four different memory stages: 1) recent memory (1-minute delay) expressed by a novelty preference, 2) transition memory (1 day – 1 week delay) expressed by a null-preference, 3) remote memory (1 – 3 months delay) indicated by a familiarity preference, and 4) inaccessible memory (more than 3-months delay) indicated by no preferences. Based on this model, the found null-preference in the present study may represent the kind of memory Bahrick and Pickens (1995) defined as transition memory, i.e., children's memory for the action scenes was accessible, but did not manifest in any preference. One finding that may be indicative for children's accessible memory is their attention to the actor's face during baseline and response window. Children looked significantly more frequently at the familiar facial expression in the baseline window than the response window, which suggests that they remembered the familiar facial expression and, thus, the familiar action scene.

When children had access to the intrinsic input property (i.e., actor's face) why they did not show a preference for the familiar facial expression when asked to remember the familiar verb? First, one may assume that the emotional information had no influence on children's verb meaning formation. That is, children at 24 months already know that the facial expression someone is displaying while, for example, waving a balloon is irrelevant for learning the verb that is referring to the waving action. Thus, the 24-month-olds in the present study might have acquired an abstract meaning independent of the specific emotional input property of the learning event. This interpretation, however, is called into question in some respects when we consider the individual differences in children's attention to the actor's facial expression. Here, the analyses showed that the amount of attention to the intrinsic input property during verb learning may indeed influence children's verb interpretation during the memory test. This alternative interpretation is discussed in detail below (see section 8.3.5).

One aspect that might have also contributed to the found null-preference is children's perception of the emotional input property during verb learning. In the section above (see 8.3.1), it was already pointed to the fact that children in Study 2 demonstrated lower social cognition scores than those in Study 1. As a result, children potentially did not recognize the emotional information conveyed by the actor's facial expression and, hence, did not regard the intrinsic input property for verb meaning formation and interpretation, respectively, during the memory test. Again, this interpretation is called into question when we consider the individual variability to the intrinsic input property and its effect on children's memory performance, which is discussed in section 8.3.5.

The most likely reason for the found null-preference between the baseline and response window in the memory test is the fact that no reminder question was presented before the start of the baseline window. Thus, children reactivated their memory for the familiar verb right within the baseline window, where they watched the familiar action event for the first time again after the one week delay. This might have provoked that children preferred to look at the familiar action scene, and they continued to look at this scene during the response window, because the test sentence containing the familiar verb was presented. In contrast, the presentation of a reminder question before the start of the baseline window might have elicited an earlier activation of the verb concept, which would have resulted in a greater preference for the novel action scene in the following baseline window (see the discussion in section 7.3.1). Please recall that a novelty preference is assumed when children remember the familiar information and, thus, recognize that the novel information differs from the familiar representation. The presentation of the familiar verb in the following response window might have caused children to direct their attention toward the action scene they regard as the one that matches the familiar verb. In this way they might have demonstrated the predicted attentional shift that should have shed light on their verb interpretation (see the predictions in 8.1.6.3). In sum, an effect of the intrinsic input property was probably not measurable, because of issues in the experimental design, which suggests that the assumption of an influence of the intrinsic input property on children's verb meaning formation should not be refused already.

The decision to exclude the reminder question from the memory test was made based on the results of Study 1. Here, it was not entirely clear what kind of effect – novelty or familiarity effect – the reminder elicited in children from the verb learning groups, because their looking pattern was similar to those in the control group learning no verb (see section 7.3.1). Moreover, compared to the time delays postulated by Bahrick and Pickens (1995) several other studies reported diverging delays after which a novelty, null, or familiarity preference occurs (Courage & Howe, 1998). For example, Pascalis, de Haan, Nelson, and de Schonen (1998) observed novelty effects in three- to six-month-olds after a one-day delay – Bahrick and Pickens (1995) suggested to find a null-preference in this transition phase –, whereas Fagan (1973) found novelty preferences in six-month-olds after two weeks. Based on these inconsistent results, it was unclear what to expect when no reminder question was presented. Replications of Study 2 should consider involving a reminder question in the memory test to draw more detailed inferences about the found effects in Study 1 and 2.

8.3.3 The influence of the intrinsic input property on children's attention and processing during verb learning

The results of the learning test indicated that children's attention to the facial information varied as a function of the time window. That is, children paid more attention to the actor's face while contrasting and matching the familiar information in the test phase than during verb encoding in the familiarization phase. Research on early attention and recognition memory employing habituation and preferential looking procedures generally assume that infants' looking duration is indicative for cognitive processing (Bornstein, 1985; Colombo & Mitchell, 1990). Studies provided evidence indicating that phases of focused attention are associated with intense looking (Lansink & Richards, 1997; Ruff, Capozzoli, & Saltarelli, 1996), efficient information processing, e.g. enhanced learning and memory of novel stimuli (Richards, 1997; Richards, 2003), and less distractibility by peripheral information (Richards & Turner, 2001; Ruff et al., 1996).

Based on this evidence, the increased level of attention to the actor's facial expression in the test phase may reflect that children processed the facial information more intensively than in the familiarization phase. This different level of processing may be related to the different cognitive task of verb encoding (familiarization) and verb retrieval (test phase) children had to accomplish in the two time periods. Possibly, children relied more on the facial expression in the test phase, because they consulted the facial information for contrasting the familiar and novel action scene and recognizing the familiar verb-action pair. Given this interpretation, the question is why children used the facial information for verb meaning interpretation at test: As the current study assumes, children's verb meaning formation may be influenced by their attempt to interpret the internal state that is conveyed by the actor's facial expression. This attempt may cause children to regard the actor's internal state as part of the novel verb meaning. Hence, the increased looking toward the actor's face in the test phase may reflect that children actually considered the actor's internal state for verb meaning formation and, thus, contrasted novel and familiar test scene not only in terms of the presented action pattern, but also in terms of the internal state message that was displayed by the actor's facial expression in both scenes. Although it is an assumption that children regard the facial expression as cue for an actor's internal state (i.e., intentions and emotions), a study by Poulin-Dubois and Forbes (2002) may indirectly support this hypothesis. Their study provides evidence that 2-year-old children consider subtle intentional cues of an actor for verb meaning formation. Poulin-Dubois and Forbes taught 21- and 27-month-old children novel verb pairs. The actions that were labeled by the verbs in each verb pair could be differentiated either in terms of the movement type and the actor's intention (expressed by the actor's eye gaze and gestures) or by the actor's intention only, because they were similar in the displayed movement pattern. Whereas the younger age group was able to differentiate between verbs solely when the movement pattern between the actions differed, the 27-month-olds regarded also the actor's intentional cues for mapping each verb onto the right meaning. This result suggests that children with increasing age consider very subtle cues of the actor for contrasting similar action patterns in verb learning, which comes close to the assumption formulated above that children in the current study consulted the facial expression for identifying the correct verb-action pair at test.

Indeed, the formulated assumption as well as Poulin-Dubois and Forbes' (2002) results have in common that they afford two kinds of interpretation. On the one hand, children may acknowledge the perceptual features of an eye gaze or a facial expression as useful in differentiating between the actors performing the actions that are labeled by different novel verbs. On the other hand, they might interpret these perceptual features as intentions or internal states in actions which are strongly associated with the performed action of the actor and, thus, are part of their verb meaning. The current study prefers the latter interpretation; however, further research is required to investigate this issue in greater detail.

8.3.4 Children's attention to the intrinsic emotional input property as a function of emotional valence

Interestingly, the verb neutral group paid more attention to the displayed facial expression during verb learning than children from the verb negative group. This result suggests two interpretations: either the negative group avoided looking toward the actor's face, because they associated the angry facial expression with subjective negative experiences, or the neutral group demonstrated a novelty effect for the neutral facial expression. Prior empirical evidence and the results of the rating experiment in the present study (see section 7.1.2.1.2) suggest the latter interpretation. First, the rating of the visual stimuli by 4- to 6-year-old children yielded that children had more difficulties in evaluating the neutral than negative facial expressions, what suggests a greater unfamiliarity with the neutral category. Second, the novelty hypothesis obtains support from studies reporting changing novelty preferences for facial expressions as a function of children's age and emotional experiences (Grossmann et al., 2007; Vaish et al., 2008). For example, de Haan and colleagues observed that 7-month-olds, attributed with high positive affectivity and with mothers showing fearful expressions less often, responded with longer looking and heightened neural sensitivity to presented fearful faces (Haan, Belsky, Reid, Volein, & Johnson, 2004). This response was interpreted as a novelty effect which resulted from children's rare experiences with fearful expressions. De Haan et al.'s interpretation is in line with research that has consistently observed longer looking toward novel compared to familiar stimuli. This behavior can be explained by children's attempt to match the perceived novel information with some stored mental representation (Fantz, 1964): If the child has no representation for the presented stimulus or the representation is incomplete, the stimulus obtains increased visual attention (Bornstein, 1985; Hunter & Ames, 1988; Sokolov, 1963). In light of this, the heightened attention to the neutral facial expression may reflect children's unfamiliarity with this category resulting in the attempt to construct a mental representation for this stimulus.

Moreover, the novelty effect provokes to ask if it reflects the assumed interaction of social cognition and linguistic competence in lexical learning. Assuming that children in both groups interpreted the 'emotional' message displayed by the actor's facial expression while constructing a lexical concept for the novel verb, the neutral group might have had difficulties in integrating the emotional message into the lexical concept, because a concept for the unfamiliar neutral category was still 'under construction'. Thus, the novelty effect might not only reflect the attempt to mentally represent 'neutral', but to integrate this information into the representation of the novel verb meaning, which resulted in increased attention and processing. One aspect that might support this interpretation is the finding that children in the verb neutral group compared to those in the negative condition devoted significantly more attention to the facial expression when presented with the test question (e.g. *Where is the man telping the balloon?*).

In further investigations, control groups learning no verbs, but watching identical visual action scenes, should be involved. If the visual attention in the actor's facial expression is actually indicative of interactions of social cognition and lexical learning, one may expect that the control groups show less interest in the displayed facial expressions as compared to the verb learning groups and in particular as compared to the verb neutral group.

8.3.5 Individual factors determining the influence of the intrinsic emotional input property on verb learning and memory

The analyses considering the influence of emotional valence, i.e., neutral and negative, on children's verb learning and memory performance revealed no results. That is, children in the negative and neutral group learned and remembered the verbs comparably. Hence, one may assume that the intrinsic emotional input property had no influence on children's verb meaning formation. However, the analyses considering children's individual preferences for the actor's facial expression suggest that the influence of the intrinsic input property is determined by individual factors. The analyses yielded that children's attentional differences regarding the displayed facial expressions in the neutral and negative condition correlated with their language competence and attention performance in the learning experiment. Further, they revealed that the difference of attention to the facial expression was consistent across the learning and memory experiment. These findings suggest that the attention to the intrinsic input property was influenced by individual factors in the learning experiment, which might have contributed to an individually varying influence of the intrinsic input property on children's verb meaning formation. In particular, children with higher productive language scores, increased attention performance (indicated by switches of attention and number of fixations at test), and more attention toward the actor's face during verb learning were also those children who looked rather toward the familiar action scene when asked to remember the familiarized verb than children with lower scores in the mentioned parameters. However, the difference in memory performance seems to have interacted with the emotional valence (negative vs. neutral) of the displayed facial expressions: while in the neutral condition children from both groups demonstrated a shift toward the familiar item during the presentation of the test question, in the negative condition both groups differed in their looking pattern as outlined before.

8.3.5.1 The influence of individual factors on verb learning

The found inter-individual variability in visual attention, language, and emotion perception (i.e., the interest for the actor's facial expression) provokes to ask how these three parameters interacted with each other so that some children were more interested in the intrinsic input property than others while verb learning. Research on emotion perception, attention, and processing capacities revealed stable inter-individual variation and suggest that individual differences in each of these domains might have contributed to the question of how children processed the novel verb-action pairs and considered the intrinsic input property in the verb encoding process.

First, studies revealed inter-individual differences in attention, processing speed, and recognition memory in infancy and childhood. In infants younger than 12 months of age it was observed that the duration of looks and the rate of attentional shifts were correlated with infants' processing speed. Infants with short looks and higher shift rates required less time to habituate on a presented stimulus than infants with longer looks and lower shift rates (Colombo, Mitchell, Coldren, & Freeseman, 1991; Freeseman, Colombo, & Coldren, 1993; Jankowski & Rose, 1997; Rose et al., 1999). Further, short looks and higher shift rates were associated with better recognition memory, indicated by increased novelty preferences (Rose, Feldman, & Jankowski, 2001), and the retention of information over longer delays (Courage & Howe, 2001). In the second year infant's attention system is thought to be subject to developmental change, i.e., longer looks are associated with a growing ability to voluntarily direct attention (executive attention) and focus on an object of interest while inhibiting distracting information (Colombo & Cheatham, 2006; Ruff & Capozzoli, 2003). Thus, longer looks seem to indicate focused attention and enhanced information processing by the second year of age (Reynolds et al., 2013). Moreover, results suggest that individual differences in processing speed, attention, and recognition memory in infancy show long-term continuity across early and later childhood and predict the development of cognitive abilities such as IQ and language (e.g. Rose, Feldman, & Jankowski, 2009; Rose, Feldman, & Wallace, 1992; Rose, Feldman, Jankowski, & van Rossem, 2012; Ruff, Lawson, Parrinello, & Weissberg, 1990).

This evidence corresponds to findings in the present study and suggests that children's individual level of processing speed and language competence contributed to differences in encoding the novel verb-action pairs. Namely, the different attention performance of the two facial preference groups during the baseline window of the learning test seems to have resulted from different capacities to process the novel verb-action pair during familiarization. Please recall that in the baseline window it was tested whether children demonstrate recognition memory, which they can only exhibit if they have sufficiently encoded the familiarized verb-action pair to contrast it with the novel information. Therefore, the increased attention performance of the facial preference-high group seems to reflect better recognition memory, which resulted from more efficient processing of the verb-action pairs during familiarization. The longer and more frequent fixations of this group (indicated by the descriptive results) during verb familiarization as compared to the facial preference-low group may support this interpretation, because they suggest that children were more actively engaged in information processing. Based on these processing differences, one may assume that children's language competence and processing speed have also determined in parts their attention to the intrinsic input property while verb learning. Children in the facial preference-high group might have paid more attention to the actor's face, because their higher level of language competence bought them time to focus more extensively on the facial information. This interpretation would be in accord with the assumption that the perception of emotional input properties conveyed by the verb's referents is closely connected to children's knowledge about the semantic and morpho-syntactic properties of verbs. In particular, it was predicted that children's ability to identify an unfamiliar lexical item as a verb will determine their ability to detect the verb's referents in their visual input and, likewise, the intrinsic input property (i.e., the facial expression) displayed by the verb's referent. Thus, the greater semantic and morpho-syntactic competences of the facial preference-high group might have enabled this group to identify the unfamiliar word as a verb more easily and map it with the corresponding perceptual input, which resulted in faster detection and extended fixation of the actor's facial expression.

Apart from language competence and processing speed, studies suggest that individual variability in emotion perception might have contributed to the variation in children's attention to the intrinsic input property. There is evidence that infants and children individually differ in their perception and processing of social-emotional input information, e.g. emotional facial expressions, which was associated with children's temperament, parental empathy, and genetic dispositions (Martinos, Matheson, & Haan, 2012; Upshaw, Kaiser, & Sommerville, 2015). Recently, Grossmann and colleagues have shown that genetic variety, affecting the hormonal concentration in neural structures, determines the individual processing of emotional facial expressions in infants and correlates with infants' temperament (Grossmann et al., 2011).

Beyond that, evidence militates for the assumption that children's individually varying language competence and emotion perception may reflect individual differences of an underlying factor that contributes to variation in both domains. Recent results suggest that individual differences in emotion perception and language competence may be ascribed to variations in the development of attentional control (e.g. Martinos et al., 2012; Mundy et al., 2007). In the present study, the descriptive results indicated differences in the visual attention pattern during verb learning, which may point to individual differences in attentional control. Namely, children in the facial preference-high group fixated the action events longer and more frequently than the facial preference-low group. A study by Papageorgiou and colleagues provides evidence for this interpretation. They investigated the fixation duration of children between four and ten months of age by using eye-tracking and related their performance to the level of behavioral and attentional control they demonstrated at a mean of three years of age. Children with longer fixation durations displayed also higher levels of attentional control (Papageorgiou et al., 2014). A more detailed discussion of studies pointing to the critical role of attention regulation for the development of language and emotion perception is given in the general discussion (see section 9.2.3).

Taken together, individual differences in emotion perception, attention, and language competence/processing might have influenced children's verb learning and potentially determined to what extent children regarded the intrinsic input property for verb meaning formation. With respect to this finding, the implementation of an intrinsic emotional input cue in a word learning paradigm seems to provide the possibility of directly linking the parameters of executive attention, language, and emotion perception with one another and study individual processes in these three parameters. The current approach may be one step forward compared to previous investigations. Previous studies have examined individual differences either in the relationship of executive attention and emotion perception (e.g. Martinos et al., 2012) or in the relationship of executive attention and language (e.g. Morales et al., 2000), but not in the interaction of all three parameters. Additionally, none of these studies investigated individual differences in the three parameters by using a (word) learning paradigm. Thus, for further studies the current approach might provide the possibility to investigate the interaction of these parameters inter- and intra-individually more systematically across development than it has been done before.

8.3.5.2 The influence of individual factors and emotional valence on verb memory

The fine-grained analysis of children's looking behavior in the response window of the memory test suggests that the influence of the intrinsic input property on children's verb meaning formation might have been affected by certain factors in the learning experiment. These factors might be individual differences in children's emotion perception, language competence, and attentional control, on the one hand, and children's familiarity with the emotional input property, on the other hand. In the previous section, it was already discussed how individual differences between children might have affected their attention to the intrinsic input property and their processing of the novel verb-action pairs. That is, children devoting more attention to the actor's face and with greater language proficiency also processed the novel verb-action pairs more efficiently than children with lower attention rates to the intrinsic input property and language competence. The influence of these factors on children's processing of the intrinsic input property while learning the verb might have resulted in the looking pattern children demonstrated during the presentation of the test question (*Where is the man telping the balloon?*) in the memory test: Those children who paid less attention to the facial information and processed the verb-action pair less efficiently in the learning experiment, i.e., the facial preference-low group, turned more frequently toward the action scene presenting the novel facial expression before recognizing the familiar action scene. Those children who paid more attention to the actor's face and processed the verb-action pair more efficiently during the learning experiment, i.e., the facial preference-high groups, turned rapidly toward the familiar action scene, but also lost their interest equally rapidly. A similar difference in the looking performance between the two facial preference groups was not observed in the response window of the learning test. There, the facial preference-low group was as fast as the facial preference-high group in matching the novel verb with the corresponding action scene. This suggests that the facial preference-low group had no difficulties in recognizing the corresponding verb-action pair when the presented action scenes differed in the displayed action pattern. Longer latencies in their reaction time to the presented verb only occurred when the distinguishing criterion between the familiar and novel scene was the presented facial expression. Additionally, in section 8.3.4 it was discussed that children's attention to the intrinsic input property was determined by the emotional valence of the input property. That is, children in the neutral condition paid more attention to the actor's face than those in the negative condition, possibly because the unfamiliar neutral facial expression required more attention from children to construct a concept for 'neutral' and to integrate this representation into the lexical concept of the novel verb. Children's familiarity with the emotional valence of the presented facial expression in the learning experiment seems to have additionally interacted with their performance in the memory test. Instead of shifting their attention toward the novel action scene, like the facial preference-low group in the negative condition, children from the facial preference-low group in the neutral condition directed their attention toward the familiar action scene as rapidly as the facial preference-high group in this condition. This behavior might be explained in terms of the increased attention children in the neutral condition paid to the actor's facial expression during verb learning, which might have caused that they rather associated the verb with the familiar facial expression than the facial preference-low group in the negative condition. Taken together, children's looking behavior in the memory test seems to result from the amount of attention they paid individually to the intrinsic input property during verb learning. The amount of attention during the verb learning process seems to be in turn determined by the mentioned individual factors and children's familiarity with the emotional valence of the input property. These inferences are made with great caution, because they rest on fragile results, i.e., predominantly descriptive data.

To verify the formulated inferences, Study 2 warrants replication. Moreover, further investigations should study in greater detail to what extent the individual differences in emotion perception, language competence, and attentional control have contributed to children's attention to the intrinsic input property while verb learning. For example, the familiarization time during verb learning may be adapted to children's individual language competence and processing speed by using a habituation to criterion procedure. In this procedure the action scenes are presented until children's interest for the action scenes decreases, which may increase the chance that children sufficiently perceive the intrinsic input property during verb encoding and consider it for verb meaning formation. In case children pay less attention to the facial information after all, this might be attributed to individual differences in other domains, e.g. emotion perception. Furthermore, it should be attested whether the faster attentional shift toward the familiar test scene of the facial preference-high group was an artefact of low-level attention processes. It is quite possible to draw such a conclusion, because the visual information was identical in the learning and memory test. This issue may be resolved as follows: In the memory test, children are presented with two action scenes that display events that are identical in the action but differ in the facial expression of the actor performing the action. Due to the previous learning experiment, the action as well as one of the two facial expressions posed by the actor is familiar to them. Simultaneously, children listen to a novel pseudo-verb, which match neither of the action events they have watched in the learning experiment. If children assume that the novel verb corresponds to the action that involves the facial expression they have not viewed in the learning experiment, this may be a clearer proof that they interpret the actor’s facial expression as a part of the verb’s meaning. Moreover, the use of identical information during learning and memory, which is a common procedure to test children’s short- and long-term recognition memory in VPC tasks, generally does not provide the opportunity to examine whether children form abstract representations of the presented stimuli. Therefore, it should be considered in subsequent experiments to additionally modulate the visual information in the memory test. For example, the action is performed by a different actor displaying the identical facial expression the child was presented with while learning the verb.

9 General Discussion and future directions

Two studies investigated whether the learning and memory of novel verb meanings in 24-month-old children is influenced by an intrinsic visual emotional input property. In these studies, the negative facial expression of an actor performing an action a novel verb is referring to was selected to examine this influence. The first study examined whether the actor's emotional facial expression influenced children's verb learning and memory processes. The second study explored whether the actor's emotional facial expression affected children's verb meaning formation.

9.1 Summary and discussion of Study 1

The results indicated that children learned and memorized the novel verbs successfully suggesting that they were able to categorize the novel words as verbs and perform a mapping between the linguistic unit and the relevant perceptual information. Based on their ability to identify the actor as referent of the novel verb, the actor's negative emotional facial expression influenced children's verb learning. Similar to studies investigating the influence of extrinsic emotional input properties on children's attention regulation and word learning (Ma et al., 2011; Moses et al., 2001; Tomasello et al., 1996) the results indicate an enhancing influence of the emotional facial expression on children's verb encoding process. Since children's visual attention did not differ as a function of the emotional condition (neutral vs. negative), it was not possible to relate the enhanced encoding to an increased level of attention. Likewise, similar to studies using extrinsic emotional cues (Schmitz et al., unpublished document) no reliably enhancing effect of the intrinsic emotional input property on children's memory performance was found. However, two parameters in children's performance, i.e., the attentional shifts and their immediate response to the request to recognize the familiarized action, suggest that the negative emotional information might have marginally facilitated memory retrieval.

9.1.1 Potential factors weakening the emotional influence on memory performance

To investigate the influence of the intrinsic emotional input property on verb memory processes in greater detail, the following factors should receive more attention in future work.

First, the decrease of emotional influence on children's memory as compared to their learning performance suggests that the one-week delay between verb encoding and memory retrieval affected the influential extent of the emotional input property. The delay embodies a period of time in which the lexical concept of the verb is subject to consolidation. It is assumed that in the process of consolidation currently acquired information is linked with information in long-term memory which is already stored (Bauer, 2004). This implies that the consolidation of the lexical concept as well as the emotional information, which is potentially associated with the lexical concept, is influenced by children's prior individual experiences (Gómez, 2011). The individual variability of previous experiences with the emotional cue, i.e., the angry facial expression, might have caused the influence of the emotional input property on children's memory performance to diminish. This aspect should be considered in further research in terms of controlling children's prior experiences with the presented emotional information (see also section 9.2.1). As studies have found, parental empathy and emotionality are associated with children's individual perception of emotional expressions and might be potential factors to account for (Haan et al., 2004; Shackman & Pollak, 2005; Upshaw et al., 2015). Likewise, longitudinal designs may be conceivable to control for children's individual prior experiences and development of social cognition in order to estimate the impact of these factors on children's perception of emotional input properties in greater detail.

Second, one may assume that children's processing speed in mapping the novel verb-action pairs during the familiarization phase might bear a direct relation to the influence of the intrinsic emotional input property during memory retrieval. Children's individual processing speed (Rose et al., 2012) in correspondence with their current linguistic competence may determine how fast children identify the novel lexical item as a verb and detect the verb's perceptual referents involving the intrinsic emotional information (i.e., the facial expression) conveyed by the referents.

A greater variability in processing speed may have the effect that some children categorize the verb and the corresponding visual information, involving the intrinsic input property, faster than others, which implicates that the emotional input property is more efficiently processed. Over the one week delay between the learning and memory experiment the encoded information is subject to further consolidation processing. This may additionally contribute to individual variability, because the current information is integrated into existing information structures and thereby is depending on experiences that individually vary between children (see the argumentation above). Hence, both factors – the variability in processing during encoding as well as the variability during consolidation – might cause a diminished effect of the intrinsic emotional input on children's memory performance. For this reason, the individual processing speed should be controlled by using a habituation to criterion procedure for the familiarization phase: Here, the action scenes are repeatedly presented until children's looking decreases below a certain criterion (e.g. Horowitz, Paden, Bhana, & Self, 1972). The decrease of looking is thought of as reflecting a decrease of children's interest, which results from completed encoding of the presented stimulus. This method might be more sensitive to control for individual processing than the employed fixed-trial procedure of the present study. Here, children were familiarized with the novel verb-action pairs within a fixed amount of time while neglecting their individual processing capacities (for further discussion, see section 7.3.1.2).

Third, the missing effect of the emotional information on memory performance may be associated with the arousal level of the negative emotional expression. A frequently used framework suggests that emotional stimuli can be characterized in terms of two dimensions: valence (ranging from positive to negative) and arousal (ranging from high to low; e.g. Kensinger & Corkin, 2004; Russell, 1980, see also Chapter 2). For example, a facial expression conveying the negative emotion *rage* might be experienced as more arousing than a face expressing the negative emotion *anger*. Studies revealed that emotional arousal results in enhanced memory consolidation (e.g. Sharot & Phelps, 2004; for a review, see LaBar & Cabeza, 2006). Emotionally arousing stimuli cause the release of stress hormones (adrenaline and cortisol), which activate the amygdala, the central hub of the emotion processing network. The amygdala, in turn, can modulate the processing of these stimuli resulting in enhanced memory consolidation (McGaugh, 2000). Evidence indicates that adult participants' memory for events or pictures varied directly with the arousal level of the stimuli (e.g. Anderson, Wais, & Gabrieli, 2006; Bohanek, Fivush, & Walker, 2005). In the light of this evidence, it is at issue now to what extent the negative emotional facial expression was experienced as emotionally arousing by the two-year-olds. If the emotional cue was of mild or moderate arousal, it might have had no effect on memory consolidation. Meanwhile, the marginal effects in children's attentional switches and response rapidness may indicate that children in the negative condition benefited from the emotional information presented in the moment of memory retrieval. To provide more details on whether the marginal memory effect was associated with the arousal level of the emotional facial expression, the arousal level of the emotional input property might be varied in intensity in further investigations. Additionally, children's arousal might be controlled by using methods like pupillometry. In adults and infants it was found that the pupil diameter changes as a function of emotional arousal (Bradley et al., 2008; Geangu, Hauf, Bhardwaj, & Bentz, 2011; Upshaw et al., 2015). In particular, negative and positive emotional stimuli elicited more arousal and greater pupil dilation than neutral stimuli. Thus, pupillometry might be a suitable tool to investigate the influence of emotional arousal on children's verb memory. Moreover, a recent study by Upshaw et al. (2015) indicates that 12- and 15-month-olds' pupil dilation in response to others' emotional expressions individually differed among children and was associated with parental empathy. That is, infants of parents who rated their own competences in terms of empathic perspective taking and prosocial behavior as being higher showed greater responses to the emotional stimuli than infants of parents who rated their own competences being lower. The authors suggest that this individual variation of emotional arousal may be indicative of early variation in empathic capacities. Thus, pupillometry in association with the assessment of parental personality traits may provide the opportunity to study in greater detail whether children regard the emotional facial expression as conveying an internal state message and how this process individually influences children's verb learning.

9.2 Summary and discussion of Study 2

Similar to Study 1, children were able to learn the novel pseudo-verbs. Contrary to Study 1, the results revealed no enhancing influence of the negative emotional input property on children's verb encoding process. Potential reasons for this finding may be seen in the fact that levels of social cognition are less developed in children, which is supported by a subsequent analysis using matched sub-groups (see section 8.3.1). Another unexpected finding revealed that children in the verb neutral group exhibited significantly more attention to the displayed neutral facial expressions. Moreover, the predicted influence of the negative emotional input property on children's verb meaning formation was not found. In the memory test, children did not prefer the action scene that displayed the actor's facial expression they had viewed during verb learning one week before. Instead, the results suggest that children's perception of the intrinsic input property while verb meaning formation may be subject to individual variability. Children's consistently individually varying attention to the intrinsic input property across the learning and memory experiment was correlated with their language competence and interacted in parts with their verb interpretation in the memory test. This supports the assumption that the perception and influence of the intrinsic input property on children's verb meaning formation is determined by their individual ability to identify the novel pseudo-word as a verb and recognize the actor conveying the emotional input property as the verb's argument. Beyond that, the variation in the attention to the intrinsic input property may be ascribed to individual differences in emotion perception and attention regulation. The individual perception of the intrinsic input property while learning the verb determined in some respects children's verb interpretation in the memory test. Additionally, children's verb interpretation might have been influenced by their familiarity with the intrinsic input property during verb learning.

9.2.1 The influence of the intrinsic emotional input property associated with children’s social cognition and prior experiences

The learning experiment of Study 2 revealed two unexpected findings. First, the intrinsic emotional input had no enhancing influence on children’s verb learning process. In the previous discussion of Study 2, the interpretation was offered that children’s lower level of social cognition might have reduced the attention to and processing of the emotional information, which led to no enhancing effect on verb learning (see section 8.3.1). Second, children in the neutral condition were more focused on the actor’s facial expression than children in the negative group. It was already discussed that the heightened attention in the neutral group may reflect children’s unfamiliarity with neutral facial expressions (see section 8.3.4). Both findings indicate that the perception and processing of the emotional input property might have been influenced in a top-down manner by children’s current state of social cognition and their prior experiences.

In line with this assumption, there is some evidence in infancy and later childhood showing that children’s emotion perception is shaped by their previous experiences with the presented emotional information. Kahana-Kalman and Walker-Andrews (2001), for example, observed that infants could match an emotional face and a corresponding vocal expression earlier when they were portrayed by their own mothers compared to when they were displayed by an unfamiliar person. De Haan et al. (2004) demonstrated that 7-month-olds’ unfamiliarity with fearful faces resulted in heightened attention allocation. Additionally, a study by Shackman and Pollack (2005) found that maltreated school-aged children demonstrated an attentional bias for anger expressions presented by their own mothers, but not for anger expressions of a stranger. Apart from these results, evidence is rare about the role of experiential influences on children’s emotion perception in early pre-school years, especially in the age group investigated in the present study. Likewise, the role of two-year-olds’ social cognition in emotion perception has been examined from a relatively one-sided perspective. Namely, it was predominantly studied how children perceive extrinsic emotional expressions in child-adult interactions and regard them as referential cues (see Chapter 2.1.2 and 4). Meanwhile, research seems to have neglected the question of how children’s evolving social cognition affects their perception of intrinsically presented emotion expressions in word learning settings, where it depends on the child alone to regard emotional information as relevant for word meaning acquisition. Thus, more evidence according to these open issues is required to better interpret the current results.

With respect to further studies, it is suggested to investigate the impact of children's developing social cognition on their perception of intrinsic emotional input properties in word learning settings more systematically by cross-sectional and longitudinal designs. Here, it should be focused on the following question: How does the attention to intrinsic emotional input properties in a word learning task change as a function of children's age, social cognition, and prior experiences with the presented emotional cue? Results of studies that have examined infants' attention to complex action events in movies suggest that children might pay more attention to the intrinsic emotional information with increasing age, social, and linguistic competence. Richards and colleagues presented children between three and 24 months of age with a complex audio-visual Sesame Street movie and simple dynamic visual stimuli (e.g. rotating stars) synchronized with auditory information (Richards & Cronise, 2000; Richards & Gibson, 1997, reviewed in Richards, 2010, pp. 206–208). They tested children's attention to both kinds of stimuli. Only the 12- to 24-month-olds showed reliable differences in their attention to both stimuli types by demonstrating more attention to the complex Sesame Street movie. Similarly, Frank and colleagues found that infants between three and nine months of age showed a gradually increasing attention to faces in animated movies (Frank, Vul, & Johnson, 2009). Moreover, Stevens and Richards (2006, in Richards, 2010, pp. 211–213) found that 18- to 24-month-old children only displayed heightened attention when the visual and auditory information corresponded in a meaningful way, i.e., videos with 'backward speech' obtained no increased attention. Given the general assumption of the present study that children interpret the emotional input property as relevant for word meaning formation this finding leaves to assume that the attention to intrinsic emotional input properties will increase when children are presented with a word learning task.

Finally, a completely open question is how children's attention to emotional input properties of different emotional valence interacts with their social and linguistic competence as well as their individual experience across development.

9.2.2 The influence of the intrinsic emotional input property associated with children's knowledge about the semantic and syntactic properties of verbs

The results of the memory test in Study 2 suggest that the negative emotional input property did not influence children's verb meaning formation. In the previous discussion of Study 2, it was assumed that children might have regarded the emotional facial information as irrelevant for verb learning and formed an abstract verb meaning (see section 8.3.2). This interpretation is called into question by findings showing that 24-month-olds' ability to form abstract verb meanings is restricted. They seem to regard specific features of the verb's referents, especially features of the participant actor, as relevant for novel verb meaning formation. This prevents them from abstracting novel verb meanings as studies have shown. Maguire and colleagues, for example, familiarized 18-, 24-, and 30-month-olds with novel verbs that referred to action events displaying an actor performing an action (Maguire et al., 2006). At test, children watched a novel actor performing the familiarized action on one side of the screen and another novel actor performing a novel action on the other side. Children at all ages were not able to extend the familiarized verb to the novel actor-familiar action scene. Based on this finding, it seems unlikely that children in the present study actually constructed an abstract verb meaning. Rather, it seems that the participant actor as referent of a novel verb meaning plays an extraordinary role in children's verb meaning formation and the question should be why this is happening. Is it possible that features of intentional agency of animate actors, e.g. goal-directedness, animacy, emotional expressions, cause children to combine a novel action, which is labeled by a novel verb, exclusively with the particular actor who was introduced with the novel action? Because even though 24-month-olds are not able to abstract the participant actor of a novel verb meaning, they are able to abstract an inanimate participant object. Arunachalam and Waxman (2010) familiarized 24-month-olds with novel verbs and corresponding action scenes involving an actor performing an action on an inanimate object. At test, children were presented with two action scenes side-by-side. The familiar scene displayed the familiar action and a novel object, while a novel scene depicted a novel action and a familiar object. Children succeeded at this task such that they were able to extend the verb meaning to the familiar action-novel object pairing. Thus, in cases where the object referent is lacking characteristic features of animacy and intentionality children, indeed, abstract verb meanings. Taken together, specific features of the animate participant actor – possibly related to aspects of intentional agency – seem to interfere with children's ability to form abstract verb meanings. Assuming that emotion is a characteristic feature of intentional agency, the reported findings of previous studies suggest that the intrinsic emotional input property of the present study might have played a role in verb meaning formation, but remained uncovered based on methodical issues, i.e., the missing reminder question, and children's social cognition being less developed. In section 8.3.1 and 8.3.2, it was suggested that both factors might have contributed to the result that no enhancing effect on children's verb learning was found. Thus, before the hypothesis is refused that the intrinsic emotional input property is affecting children's verb meaning formation, design modifications and more fine-grained methods should be taken into consideration to examine the hypothesis in greater detail. Moreover, the finding that the influence of the intrinsic input property on children's verb interpretation in the memory test might have been determined by individual factors (i.e., variability in processing speed, language competence, attentional control, emotion perception see section 8.3.5) militates for the suggestion to investigate the hypothesis more extensively. The contribution of individual factors suggests that the intrinsic emotional input might play a role for verb meaning formation, but its influence should be investigated with due regard to individual variability in linguistic competence (i.e., syntactic and semantic knowledge), attentional control, and social cognition across development.

With reference to the found correlation of children's attention to the intrinsic input property and their linguistic competence, the interpretation was offered that children with greater linguistic proficiency were able to identify the novel pseudo-words as verbs more easily and, thus, were able to pay more attention to the actor's facial expression. This interpretation met the general prediction that children's ability to identify an unfamiliar lexical item as verb should contribute to the rapidness in detecting and processing the verb's referents in their visual input and, likewise, the intrinsic input property that is displayed by these referents. In further investigations the offered interpretation should be verified by cross-sectional designs, which focus on two questions:

a) How does the attention to the intrinsic input property change as a function of children's developing linguistic (i.e., syntactic and semantic) competence?
b) How does the attention to the intrinsic input property change as a function of the word class of the presented pseudo-word?

If the interpretation is correct and children's detection and recognition of the intrinsic input property interacts with their ability to identify unknown lexical items as verbs, one may assume that children's attention to the intrinsic input property and its potential influence on their verb meaning formation will reinforce with their increasing linguistic competence. However, it might be difficult to relate the reinforcement of attention exclusively to children's changing linguistic competence, because in conjunction with children's age and growing linguistic competence also their social cognition increases. To this end, the influence of the intrinsic input property on different word classes should be considered. Given the fact that different categories of words refer to different aspects in the visual input, e.g. verbs refer to actions/events and nouns to objects, the intrinsic input property will be of different relevance for word meaning formation. Considering children's increasing understanding of this fact, it might be possible to investigate how the influence of the intrinsic input property changes dependent on children's ability to recognize that the meaning formation of a particular word class requires more or less attention to the intrinsic input property. For example, children might be presented with the +/- friendly facial expression of an actor, who is performing an action on an object (e.g. man with an angry face is waving a balloon), and a sentence containing a novel noun referring to the object of the action event, e.g. Look, the man is waving *a telp*. When children are able to categorize the unfamiliar word as a noun and identify the object (balloon) in the visual input as the noun's referent, they might also have understood that the actor's facial expression is unrelated to the intended referent of the pseudo-noun and, hence, irrelevant for the meaning of the novel noun. Accordingly, they might pay less attention to the facial expression of the actor when learning the noun and consequently their noun interpretation during a subsequent memory test might be less affected by the facial input property as compared to children learning a novel verb. In sum, investigating the differences of children's attention to and memory of the intrinsic input property while they are learning and remembering different kinds of words may help to better understand how their syntactic and semantic competence interacts with their perception of emotional information.

Beyond the question of how non-permanent emotional features of intrinsic input properties, e.g. the +/- friendly facial expression of an actor, affect children's verb learning, it should be examined how permanent intrinsic properties, e.g. +/- pleasant features of an action itself like *caressing* or *beating*, influence children's meaning formation across development. In contrast to non-permanent properties, the recognition of the emotional valence of permanent intrinsic properties suggests advanced social cognition and linguistic knowledge as a requirement. For example, while viewing an emotional action, e.g. a mother caressing her daughter, children have to evaluate the emotional valence of the caressing event by establishing a relation between the actor (mother) and perceiver (daughter) of the action and link the experience of the perceiver to their own experiences. Furthermore, they have to decide whether the transitive action qualifies as a token of the 'caress-category' by evaluating the following parameters: ±dynamic, ±durative, ±telic, ±intensive etc. With respect to these advanced processing requirements, one may assume that the attention to permanent intrinsic emotional properties and their influence on word learning may emerge later in development as compared to the influence of non-permanent properties, i.e., the facial expression of a person. Taken together, the implementation of different kinds of intrinsic emotional input properties in a cross-sectional design may allow us drawing further inferences about the interaction of social cognition and linguistic competence across development.

9.2.3 The influence of the intrinsic emotional input property associated with children's attentional control

In the previous discussion of Study 2, the following interpretation among others was offered: The individual variability in children's attention to the intrinsic input property in correlation with their language competence may reflect individual differences of an underlying factor, which contributes to variability in both domains (see section 8.3.5.1). Recent results on the role of attentional control for emotion perception and language development suggest that individual differences in both domains may be ascribed to individual differences in executive attention and self-regulation.

The anterior attention system in the brain is thought to subserve the volitional control of attention (Posner & Petersen, 1990), which involves focusing attention on a stimulus or task while neglecting distracting information (executive attention). The anterior attention system is also thought to be critically involved in the development of self-regulation (Posner & Rothbart, 1998). Self-regulation is defined as the ability to regulate emotional, attentional, and motor reactions and is one temperamental variable that constitutes individual differences (Rothbart, Sheese, Rueda, & Posner, 2011). Sheese and colleagues, for example, examined the relationship of self-regulation and executive attention in 6- and 7-month-old infants. They found that infants with higher rates of correct anticipatory looking, which is thought of as an early indicator of executive attention, demonstrated increased behavioral control and cautious approaches toward a novel toy (Sheese, Rothbart, Posner, White, & Fraundorf, 2008). In the light of this evidence, an ERP study by Martinos et al. (2012) was able to relate 3- to 13-month-olds' controlled attention allocation and self-regulation with their perception of emotional facial expressions (happy and fearful). Children's attention was measured by the event-related component *Nc* (Negative central), which was found to be triggered by parts of the anterior attention system (Reynolds & Richards, 2005). The Nc is interpreted as reflecting attention allocation, with larger Nc amplitude reflecting increased attention deployment (Reynolds et al., 2010). The results revealed that children with better self-regulation exhibited a faster Nc response to both emotional facial expressions and a greater Nc amplitude to fearful faces as compared to children with lower self-regulation capacities. This result suggests that variation in children's development of executive attention and self-regulation contributes to individual differences in their perception of emotional information.

Moreover, executive attention and self-regulation are thought of as critical determinants of joint attention (Mundy & Newell, 2007; Vaughan Van Hecke et al., 2012). Joint attention is defined as 'triadic information processing', which requires children to regulate their attention between the self, the other, and an outside entity of joint interest (Mundy & Jarrold, 2010). As outlined in Chapter 4, joint attention is an important ability for early word learning. It is indicated by children's use of extrinsic social (eye-gaze, pointing) and emotional cues (vocal expressions) to identify the referent of others' attention or draw others' attention to intended referents of novel words. Studies indicated that children individually differ in their ability to initiate (i.e., requesting attention) and respond to joint attention (i.e., following eye gaze or pointing), which was related to later differences in language competence (Morales et al., 2000; Mundy & Gomes, 1998). Mundy et al. (2007), for example, found that better responding to joint attention at nine months and initiating joint attention at 18 months, respectively, were positively correlated with children's receptive and expressive language scores at 24 months. Thus, variation in children's ability to coordinate their attention with others results in individually varying language outcomes.

Taken together, these results give rise to assume that the found variation in children's attention to the intrinsic input property in association with their varying language competence reflect differences in children's executive attention capacities. Hence, it should be considered to control for children's executive attention and self-regulation capacities in further investigations. Examining the impact of these factors on children's perception of the intrinsic emotional input property may help to understand how children individually vary in these domains and how this variability affects the perception of the intrinsic input property during verb meaning formation.

9.3 Conclusion

The investigation of the influence of the intrinsic emotional input property on verb learning processes and verb meaning acquisition revealed a complex picture. In line with studies on extrinsic emotional input properties, the first study revealed an enhancing influence of the intrinsic input property on children's verb encoding process. However, this effect was not replicated by the second study. Moreover, in both studies no reliable influence of the emotional input property on children's verb memory process or their verb meaning formation was found. Instead, the second study indicated that children's perception and processing of the intrinsic input property while learning novel verbs is subject to individual variability, which in parts seems to have influenced children's verb interpretation during the memory test after a one week delay. With respect to this finding, further research on the interaction of emotional information and verb meaning acquisition should focus more extensively on factors that might contribute to individual variability in this interaction using longitudinal and cross-sectional designs. In so doing, the employment of an intrinsic emotional input property within a word learning paradigm suggests being a suitable method for investigating these inter-individual influences in emotion-cognition interactions in greater detail.

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Summary (German)

Das Erlernen neuer Wörter stellt Kinder immer wieder von neuem vor die Aufgabe, ihre Bedeutung zu entschlüsseln, d.h. zu erkennen, worauf sie sich beziehen. Beim Erlernen unbekannter Wörter nutzen Kinder z.B. perzeptuelle, soziale oder linguistische Information im Kontext einer Wortlernsituation, um auf die mögliche Bedeutung des neu zu erlernenden Wortes zu schließen (Maguire et al., 2006). In der vorliegenden Arbeit wurde die Rolle emotionaler Kontextinformation (im Folgenden auch Inputeigenschaft genannt) beim Erwerb neuer Wortbedeutungen untersucht.
Studien liefern zunehmend Evidenz, dass emotionale Inputinformation sich förderlich auf das Erkennen, Erlernen und Erinnern von verbalen (Wörter) und non-verbalen (Bilder, Ereignisse) Stimuli bei Erwachsenen und Kindern auswirkt (z.B. Davidson et al., 2001; Kensinger & Corkin, 2003; LoBue, 2009). Darüber hinaus spielen emotionale Ausdrücke eine wichtige Rolle für Kinder, um in vorsprachlichen Interaktionsprozessen die kommunikativen Absichten ihres Gegenübers zu erfassen und ihr eigenes Handeln mit den Intentionen ihres Gegenübers abzustimmen (z.B. Friend, 2001; Moses et al., 2001). Entsprechend sozial-pragmatischer Ansätze ist die Fähigkeit dieses *intention reading* eine grundlegende Voraussetzung, um neue Wortbedeutungen in Interaktionsprozessen mit anderen zu erlernen (z.B. Bloom, 2000; Tomasello, 2008). Trotz des Stellenwerts von emotionaler Information in der frühkindlichen Kommunikation, wurde ihre Rolle für den lexikalischen Erwerb noch wenig systematisch untersucht. Bisher widmeten sich einzelne wenige Studien der Frage, wie emotionale prosodische Information das Erkennen und Erlernen von Wörtern beeinflusst (z.B. Ma et al., 2011; LoBue, 2009; Singh et al., 2004). Sie konnten wiederholt einen förderlichen Einfluss von emotional-prosodischer Information auf das Erkennen und Erlernen feststellen. Grundsätzlich lag der Fokus dieser Studien dabei auf der Frage, inwiefern emotionale Information die Wortlernleistung befördert. Völlig unberührt blieb davon jedoch, ob emotionale Information im Kontext einer Wortlernsituation auf den Aufbau bzw. Inhalt neuer Wortbedeutungen Einfluss nimmt. Insbesondere auch dieser Frage nachzugehen war Teil der vorliegenden Arbeit.

In der Arbeit wurden zwei Arten emotionalen Inputs unterschieden: extrinsische vs. intrinsische Inputeigenschaften. Als **extrinsische** emotionale Inputeigenschaften wurden

Kontextinformationen definiert, die nicht Teil des Referenten sind, auf den sich ein zu erlernendes Wort bezieht, z.B. der +/- freundliche Gesichtsausdruck eines Sprechers, der ein unbekanntes Objekt mittels eines neuen Wortes benennt. **Intrinsische** emotionale Inputeigenschaften beziehen sich dagegen auf solche Eigenschaften, die Teil des Referenten eines zu erlernenden Wortes sind, z.B. der +/- freundliche Gesichtsausdruck eines Akteurs (lächelnd vs. ärgerlich) in einer durch ein Verb benannten Handlung oder die +/- angenehme Eigenschaft der Handlung selbst (streicheln vs. kneifen). Da sich vorangegangene Studien bisher nur mit der Rolle extrinsisch-prosodischer Inputeigenschaften beim Worterwerb auseinandergesetzt haben, wurde in der vorliegenden Arbeit dem Einfluss intrinsisch-visueller Inputeigenschaften, d.h. dem +/- emotionalen Gesichtsausdruck eines Akteurs einer Handlung, nachgegangen.

Die Rolle emotionaler Inputeigenschaften beim frühkindlichen Worterwerb wurde in zwei Studien an jeweils 24 Monate alten monolingual Deutsch lernenden Kindern untersucht. Jede Studie umfasste sowohl ein Lern- als auch ein Erinnerungsexperiment. Für die Untersuchung der Fragestellung wurde das experimentelle Design von Waxman et al. (2009) übernommen, was eine modifizierte Version des *Intermodal Preferential Looking Paradigms* (Hirsh-Pasek & Golinkoff, 1996) darstellt. Bei dieser Methode wurden den Kindern Videos mit kurzen Handlungen (z.B. Ballon schwenken) gezeigt, die jeweils von einem Satz begleitet wurden. Jeder Satz enthielt ein unbekanntes Pseudoverb (‚Guck mal, der Mann *telpt* einen Ballon‘), dessen Bedeutung die Kinder anhand der Videosequenz und den bekannten lexikalischen Elementen (‚der Mann‘; ‚der Ballon‘) erschließen mussten. Im Anschluss an die Lernphase wurde überprüft, ob die Kinder die präsentierten Pseudoverben erlernt hatten (Lerntest). Dazu wurden den Kindern zwei Handlungen parallel gezeigt, wobei nur eine von ihnen der bekannten Handlung entsprach. Gleichzeitig wurden die Kinder aufgefordert das erlernte Pseudoverb wiederzufinden (‚Wo *telpt* der Mann den Ballon?‘). Im Fall, dass Kinder das Pseudoverb erlernt hatten, wurde angenommen, dass sie länger die bekannte als die neue Handlung betrachten. Nach 7 Tagen wurde getestet, ob sie die Pseudoverben auch erinnern konnten (Erinnerungstest). Um den Einfluss der emotionalen intrinsischen Inputinformation zu analysieren, wurden die Pseudoverben unter zwei emotional verschiedenen Bedingungen präsentiert. Eine Gruppe von Kindern erlernte die Verben während der Akteur der zum Verb gehörigen Handlung einen negativen Gesichtsausdruck zeigte (Verb-negativ). Eine zweite Gruppe sah dagegen denselben Akteur mit neutralem Gesichtsausdruck (Verb-neutral). Die gezeigten Handlungen waren für beide Gruppen jedoch identisch. Die erste Studie umfasste zudem eine Kontrollgruppe, die Sätze ohne Pseudoverben präsentiert bekam (‚Schau mal da!'). Dennoch sah diese Gruppe dieselben Handlungen wie die beiden Verblerngruppen, wobei der Akteur dieselbe neutrale Gesichtsmimik besaß wie in der Verb-neutral Bedingung. In das Design der zweiten Studie wurde keine Kontrollgruppe miteingeschlossen.

Für beide Studien wurde davon ausgegangen, dass der Einfluss des emotionalen Inputs auf das Verblernen vom Entwicklungsgrad der Aufmerksamkeitskontrolle, der sozioemotionalen Kompetenz und dem Wissen der Kinder über die semantischen und morpho-syntaktischen Eigenschaften von Verben abhängt. So müssen sie zum einen das unbekannte Pseudowort als der Kategorie ‚Verb' zugehörig erkennen und der entsprechenden Handlung mit ihren Argumenten zuordnen können, wobei die intrinsische Inputinformation (emotionaler Gesichtsausdruck) ein Teil eines der Argumente (Akteur der Handlung) ist. Zum anderen müssen sie die emotionale Valenz (negativ, neutral) der intrinsischen Inputeigenschaft erfassen und als Ausdruck eines internen Zustands des Akteurs interpretieren können. Demzufolge verspricht die Untersuchung der Rolle von intrinsischen emotionalen Inputeigenschaften beim Wortbedeutungserwerb eine systematische Analyse der Interaktion kognitiver, emotionaler und sprachlicher Fähigkeiten.

In einer ersten Studie wurde der Frage nachgegangen, ob intrinsische emotionale Inputeigenschaften einen förderlichen Einfluss auf die Lern- und Erinnerungsprozesse beim Erwerb neuer Wortbedeutungen ausüben. Angesichts der Evidenz bei älteren Kindern und Erwachsenen wurde davon ausgegangen, dass die Verb-negativ Gruppe eine verbesserte Wortlern- und Worterinnerungsleistung zeigt als die Verb-neutral und Kontrollgruppe. Obwohl Kinder in der Verb-neutral und Verb-negativ Gruppe die neuen Verben erfolgreich lernten, zeigten die Ergebnisse wie erwartet auch, dass sich die emotionale Information förderlich auf die Lernleistung der Verb-negativ Gruppe auswirkte. Jedoch konnte keine signifikant verbesserte

Erinnerungsleistung festgestellt werden, sondern beide Verblerngruppen erinnerten die Verben gleichermaßen gut.

In einer zweiten Studie wurde untersucht, inwiefern der intrinsische emotionale Input den Aufbau der Verbbedeutung selbst, d.h. das mentale Konzept des zu erlernenden Wortes, beeinflusst. Zu diesem Zweck wurden den Kindern im Erinnerungsexperiment zwei identische Handlungen gezeigt, die sich nur im emotionalen Gesichtsausdruck des Akteurs unterschieden. Für den Fall, dass der emotionale Input zum Aufbau einer Bedeutung beiträgt, wurde angenommen, dass die Kinder die Handlung mit jenem Gesichtsausdruck des Akteurs bevorzugen würden, der mit der emotionalen Bedingung während des Lernens übereinstimmt. Hierbei wurde auch berücksichtig, ob sich die Kinder während des Erlernens der Pseudoverben in ihrem Interesse für den intrinsischen Input unterscheiden. Es wurde davon ausgegangen, dass jene Kinder, die mehr auf den intrinsischen Input achten, auch eher durch diesen in ihrem Bedeutungsaufbau beeinflusst werden. In der zweiten Studie wurde eye-tracking verwendet, so dass ermittelt werden konnte, wie lange und in welchen zeitlichen Phasen die Kinder dem intrinsischen Input während des Lernexperiments Aufmerksamkeit schenkten. Es wurde erwartet, dass Kinder der Verb-negativ Gruppe a) wie auch in der ersten Studie einen verbesserten Lerneffekt zeigen, b) dem intrinsischen emotionalen Input verstärkt Aufmerksamkeit während des Verblernens widmen und c) sich bei Ihnen während des Erinnerungsexperiments eine Präferenz für die Handlung mit negativem Gesichtsausdruck feststellen lässt, die sie während des Lernexperiments präsentiert bekommen haben.

Bei der Auswertung des Lernverhaltens ließ sich kein förderlicher Effekt des negativen intrinsischen Inputs auf die Lernleistung nachweisen. Es wurde jedoch auch festgestellt, dass die Kinder der zweiten Studie signifikant geringere sozioemotionale Kompetenzen aufwiesen als die Kinder der ersten Studie. Eine Analyse mit einer Subgruppe von Kindern, die vergleichbare Leistungen mit denen aus der ersten Studie besaßen, konnte dagegen den positiven Einfluss auf das Lernverhalten replizieren. Weiterhin wurde anders als erwartet keine verstärkte Aufmerksamkeit gegenüber dem intrinsischen Input bei der Verb-negativ Gruppe erkennbar; im Gegenteil, Kinder der Verb-neutral Gruppe betrachteten den Gesichtsausdruck des Akteurs signifikant häufiger während der Lern- und Testphase. Eine mögliche Erklärung hierfür wäre, dass die Kinder Schwierigkeiten hatten, die neutrale Kategorie im Kontext der Verblernaufgabe zu interpretieren. Die Analyse des Erinnerungsexperiments erbrachte darüber hinaus keinen Hinweis, dass der intrinsische emotionale Input den Aufbau der Verbbedeutung beeinflusst hatte. Das heißt, weder Kinder der Verb-negativ Gruppe noch jene der Verb-neutral Gruppe präferierten die Szene mit intrinsischem Input, die sie während des Lernens gesehen hatten. In einem weiteren Analyseschritt wurden die Kinder nach ihrem Interesse für den intrinsischen emotionalen Input während des Verblernens unterteilt. Es zeigte sich, dass die Kinder mit einem größeren Interesse für den Gesichtsausdruck des Akteurs auch eine höhere produktive Sprachkompetenz besaßen als Kinder mit geringerem Interesse. Zudem spiegelte sich ihre höhere Kompetenz in einer verbesserten Verarbeitung der zu erlernenden Pseudoverben wider. Übereinstimmend mit den Annahmen lieferte die Auswertung auch Hinweise, dass die Kinder mit dem größeren Interesse für den Gesichtsausdruck des Akteurs auch stärker durch den intrinsischen Input in ihrem Bedeutungsaufbau beeinflusst worden sein könnten. Während des Erinnerungstests präferierten sie insbesondere in dem Moment, in dem sie aufgefordert wurden, das erlernte Pseudoverb zu erinnern, eher die Szene mit dem emotionalen Input, den sie beim Lernen der Verbbedeutung eine Woche zuvor gesehen hatten. Kinder mit einer geringeren Aufmerksamkeit für den intrinsischen Input zeigten einen umgekehrten Effekt. Dieses Ergebnis ließ sich allerdings nur für die Verb-negativ Gruppe feststellen.

FAZIT. Die Untersuchung des Einflusses intrinsischer emotionaler Inputeigenschaften auf den Erwerb von Verbbedeutungen ergab ein komplexes Bild. Im Einklang mit Studien zum Einfluss extrinsischer emotionaler Inputeigenschaften zeigten die Ergebnisse einen förderlichen Effekt der emotionalen Information auf den Verblernprozess der Kinder. Dagegen wurde kein positiver Effekt auf die Erinnerungsleistung festgestellt. Auch ließen sich keine eindeutigen Ergebnisse für den Einfluss des emotionalen intrinsischen Inputs auf den Aufbau neuer Verbbedeutungen finden. Stattdessen legten die Analysen nahe, dass das Erkennen und Verarbeiten des intrinsischen Inputs während des Lernens neuer Verbbedeutungen individueller Variabilität unterliegt, die darüber entscheiden könnte inwieweit der intrinsische Input die Bedeutung des zu erlernenden Verbs mitbestimmt. In der vorliegenden Arbeit wurden unterschiedliche Faktoren diskutiert, die zu dieser Variabilität beigetragen haben könnten. Zum einen wäre es möglich, das Ergebnis auf die unterschiedliche Sprachkompetenz der Kinder zurückzuführen. So könnte der Einfluss des intrinsischen emotionalen Inputs von der Fähigkeit der Kinder abhängen, das unbekannte Pseudowort als ‚Verb' zu kategorisieren und der entsprechenden Handlung mit den dazugehörigen Argumenten zuzuordnen. Umso weniger gut bzw. schnell die Kinder diese Kategorisierung vornehmen, umso schwerer dürfte es Ihnen fallen, den intrinsischen Input als Teil eines der Argumente des Verbs zu erkennen und als relevant für die aufzubauende Verbbedeutung zu erachten. Allerdings schließen die Ergebnisse anderer Studien nicht aus, dass individuelle Unterschiede in der Aufmerksamkeitskontrolle und der Wahrnehmung von emotionaler Information zu der beobachteten Variabilität geführt haben (z.B. Martinos et al., 2012; Upshaw et al., 2015). Angesichts dieser offenen Fragen sollten weitere Studien mittels längs- und querschnittlicher Designs ausführlicher auf die angesprochenen und mögliche weitere Faktoren eingehen, die zur individuellen Variabilität in der Interaktion von emotionaler Information und dem Erwerb von Wortbedeutungen beitragen könnten. Hierbei scheint sich die Verwendung von intrinsischen emotionalen Inputeigenschaften innerhalb eines Wortlernparadigmas als geeignete Methode zu erweisen, diese Faktoren eingehender zu untersuchen.

Appendices

Appendix A

Complete set of visual stimuli used in the learning and memory experiment of Study 1

Familiarization (four consecutive scenes)	**Contrast**		**Test**	
			Novel scene	**Familiar scene**
Man waving balloon	Lifting hat on head	Waving balloon	Tapping balloon	Waving balloon
Woman washing cup	Playing guitar	Washing cup	Circling cup	Washing cup
Man twirling umbrella	Sweeping floor with broom	Twirling umbrella	Spinning umbrella on shoulder	Twirling umbrella
Man pushing chair	Bouncing ball	Pushing chair	Lifting chair	Pushing chair
Woman pulling box	Playing accordion	Pulling box	Tossing box	Pulling box
Woman shaking blanket	Combing hair	Shaking blanket	Wringing out blanket	Shaking blanket

Appendix B

Complete set of auditory stimuli used in the learning and memory experiment of Study 1 and 2

Learning experiment

Trial		Familiarization	Contrast		Test	
					Baseline	Response
Waving balloon (*telpen*)	Verb	(1) Guck mal, der Mann *telpt* einen Ballon! Look, the man is telping a balloon! (2) Der Mann *telpt* einen anderen Ballon. The man is telping another balloon. (3) Siehst du das? Der Mann *telpt* einen Ballon. Do you see that? The man is telping a balloon. (4) Guck, der Mann *telpt* einen Ballon! Look, the man is telping a balloon!	Oh! Hier *telpt* der Mann nicht! Oh! The man is not telping here!	Ah! Hier *telpt* der Mann! Ah! The man is telping here!	Guck mal da! Look at this!	Wo *telpt* der Mann den Ballon? Where is the man telping the balloon?
	No word	(1) Uhi, guck mal was da passiert! Uhi, look what's happening here! (2) Schau mal da! Look at this! (3) Siehst du das? Do you see that? (4) Ei, guck mal dort! Ey, look there!	Oh! Guck mal da! Oh! Look at that!	Ah! Sieh mal! Ah! Look!	Guck mal da! Look at this!	Was siehst du da? What do you see there?
Washing cup (*biffen*)	Verb	(1) Guck mal, die Frau *bifft* eine Tasse! Look, the woman is biffing a cup! (2) Die Frau *bifft* eine andere Tasse. The woman is biffing another cup. (3) Siehst du das? Die Frau *bifft* eine Tasse. Do you see that? The woman is biffing a cup. (4) Guck, die Frau *bifft* eine Tasse! Look, the woman is biffing a cup.	Oh! Hier *bifft* die Frau nicht! Oh! The woman is not biffing here!	Ah! Hier *bifft* die Frau! Ah! The woman is biffing here!	Guck mal da! Look at this!	Wo *bifft* die Frau die Tasse? Where is the woman biffing the cup?
	No word	(1) Uhi, guck mal was da passiert! Uhi, look what's happening here! (2) Schau mal da! Look at this! (3) Siehst du das? Do you see that? (4) Ei, guck mal dort! Ey, look there!	Oh! Guck mal da! Oh! Look at that!	Ah! Sieh mal! Ah! Look!	Guck mal da! Look at this!	Was siehst du da? What do you see there?

Twirling umbrella (*lumen*)	Verb	(1) (2) (3) (4)	Guck mal, der Mann *lumt* einen Schirm! Look, the man is luming an umbrella! Der Mann *lumt* einen anderen Schirm. The man is luming another umbrella. Siehst du das? Der Mann *lumt* einen Schirm. Do you see that? The man is luming an umbrella. Guck, der Mann *lumt* einen Schirm! Look, the man is luming an umbrella!	Oh! Hier *lumt* der Mann nicht! Oh! The man is not luming here!	Ah! Hier *lumt* der Mann! Ah! The man is luming here!	Guck mal da! Look at this!	Wo *lumt* der Mann den Schirm? Where is the man luming the umbrella?
	No word	(1) (2) (3) (4)	Uhi, guck mal was da passiert! Uhi, look what's happening here! Schau mal da! Look at this! Siehst du das? Do you see that? Ei, guck mal dort! Ey, look there!	Oh! Guck mal da! Oh! Look at that!	Ah! Sieh mal! Ah! Look!	Guck mal da! Look at this!	Was siehst du da? What do you see there?
Pushing chair (*molen*)	Verb	(1) (2) (3) (4)	Guck mal, der Mann *molt* einen Stuhl! Look, the man is moling a chair! Der Mann *molt* einen anderen Stuhl. The man is moling another chair. Siehst du das? Der Mann *molt* einen Stuhl. Do you see that? The man is moling a chair. Guck, der Mann *molt* einen Stuhl! Look, the man is moling a chair!	Oh! Hier *molt* der Mann nicht! Oh! The man is not moling here!	Ah! Hier *molt* der Mann! Ah! The man is moling here!	Guck mal da! Look at this!	Wo *molt* der Mann den Stuhl? Where is the man moling the chair?
	No word	(1) (2) (3) (4)	Uhi, guck mal was da passiert! Uhi, look what's happening here! Schau mal da! Look at this! Siehst du das? Do you see that? Ei, guck mal dort! Ey, look there!	Oh! Guck mal da! Oh! Look at that!	Ah! Sieh mal! Ah! Look!	Guck mal da! Look at this!	Was siehst du da? What do you see there?
Pulling/tossing box (*glammen*)	Verb	(1) (2) (3) (4)	Guck mal, die Frau *glammt* eine Kiste! Look, the woman is glamming a box! Die Frau *glammt* eine andere Kiste. The womn is glamming another box. Siehst du das? Die Frau *glammt* eine Kiste. Do you see that? The woman is glamming a box. Guck, die Frau *glammt* eine Kiste! Look, the woman is glamming a box!	Oh! Hier *glammt* die Frau nicht! Oh! The woman is not glamming here!	Ah! Hier *glammt* die Frau! Ah! The woman is glamming here!	Guck mal da! Look at this!	Wo *glammt* die Frau die Kiste? Where is the woman glamming the box?

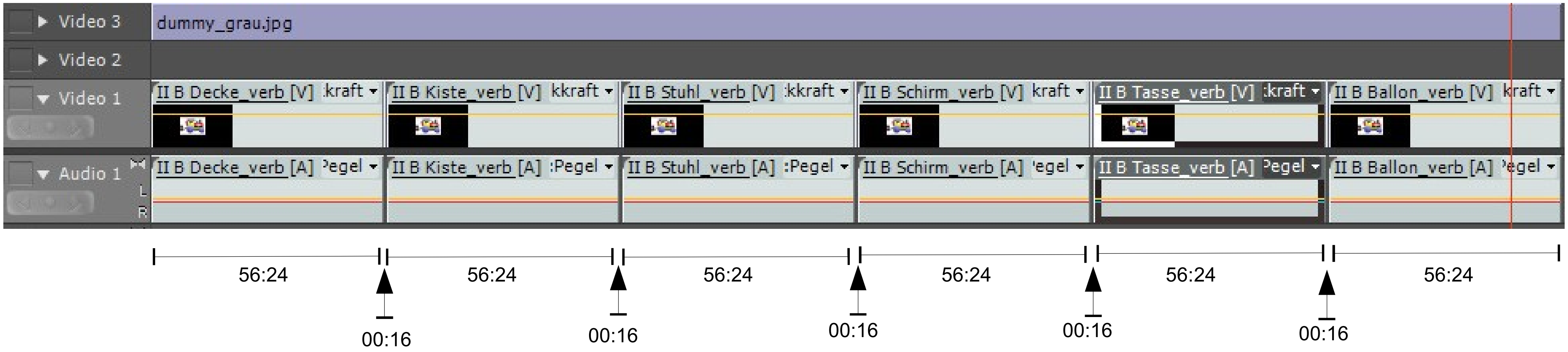
	No word	(1) Uhi, guck mal was da passiert! Uhi, look what's happening here! (2) Schau mal da! Look at this! (3) Siehst du das? Do you see that? (4) Ei, guck mal dort! Ey, look there!	Oh! Guck mal da! Oh! Look at that!	Ah! Sieh mal! Ah! Look!	Guck mal da! Look at this!	Was siehst du da? What do you see there?
Shaking blanket (*waupen*)	Verb	(1) Guck mal, die Frau *waupt* eine Decke! Look, the woman is wauping a blanket! (2) Die Frau *waupt* eine andere Decke. The woman is wauping another blanket. (3) Siehst du das? Die Frau *waupt* eine Decke. Do you see that? The woman is wauping a blanket. (4) Guck, die Frau *waupt* eine Decke! Look, the woman is wauping a blanket!	Oh! Hier *waupt* die Frau nicht! Oh! The woman is not wauping here!	Ah! Hier *waupt* die Frau! Ah! The woman is wauping here!	Guck mal da! Look at this!	Wo *waupt* die Frau die Decke? Where is the woman wauping the blanket?
	No word	(1) Uhi, guck mal was da passiert! Uhi, look what's happening here! (2) Schau mal da! Look at this! (3) Siehst du das? Do you see that? (4) Ei, guck mal dort! Ey, look there!	Oh! Guck mal da! Oh! Look at that!	Ah! Sieh mal! Ah! Look!	Guck mal da! Look at this!	Was siehst du da? What do you see there?

Memory experiment

Trial		Reminder	Test	
			Baseline	Response
Waving balloon (*telpen*)	Verb	Weißt du noch? Der Mann *telpt* einen Ballon. Do you still remember? The man is telping a balloon.	Guck mal da! Look at this!	Wo *telpt* der Mann den Ballon? Where is the man telping the balloon?
	No word	Weißt du noch? Du hast etwas geseh'n. Do you still remember? You saw something.	Guck mal da! Look at this!	Was siehst du da? What do you see there?
Washing cup (*biffen*)	Verb	Weißt du noch? Die Frau *bifft* eine Tasse. Do you still remember? The woman is biffing a cup.	Guck mal da! Look at this!	Wo *bifft* die Frau die Tasse? Where is the woman biffing the cup?
	No word	Weißt du noch? Du hast etwas geseh'n. Do you still remember? You saw something.	Guck mal da! Look at this!	Was siehst du da? What do you see there?
Twirling umbrella (*lumen*)	Verb	Weißt du noch? Der Mann *lumt* einen Schirm. Do you still remember? The man is luming an umbrella.	Guck mal da! Look at this!	Wo *lumt* der Mann den Schirm? Where is the man luming the umbrella?
	No word	Weißt du noch? Du hast etwas geseh'n. Do you still remember? You saw something.	Guck mal da! Look at this!	Was siehst du da? What do you see there?
Pushing chair (*molen*)	Verb	Weißt du noch? Der Mann *molt* einen Stuhl. Do you still remember? The man is moling a chair.	Guck mal da! Look at this!	Wo *molt* der Mann den Stuhl? Where is the man moling the chair?
	No word	Weißt du noch? Du hast etwas geseh'n. Do you still remember? You saw something.	Guck mal da! Look at this!	Was siehst du da? What do you see there?
Pulling/tossing box (*glammen*)	Verb	Weißt du noch? Die Frau *glammt* eine Kiste. Do you still remember? The woman is glamming a box.	Guck mal da! Look at this!	Wo *glammt* die Frau die Kiste? Where is the woman glamming the box?
	No word	Weißt du noch? Du hast etwas geseh'n. Do you still remember? You saw something.	Guck mal da! Look at this!	Was siehst du da? What do you see there?
Shaking blanket (*waupen*)	Verb	Weißt du noch? Die Frau *waupt* eine Decke. Do you still remember? The woman is wauping a blanket.	Guck mal da! Look at this!	Wo *waupt* die Frau die Decke? Where is the woman wauping the blanket?
	No word	Weißt du noch? Du hast etwas geseh'n. Do you still remember? You saw something.	Guck mal da! Look at this!	Was siehst du da? What do you see there?

Appendix C

Temporal structure across all 6 trials



Temporal structure of each trial

ss:ff (seconds, frames)

Appendix E

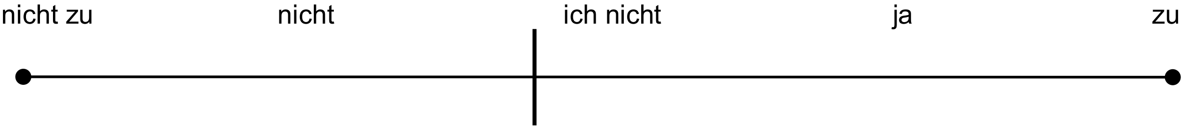
Fragebogen zur Einschätzung der kindlichen Theory of Mind
(Übersetzung des englischsprachigen *Theory of Mind Inventory* von Hutchins et al., 2012)

***Instruktion*:**
Ziel dieses Fragebogens ist es, mehr über die Gefühle und Gedanken von Kindern durch die Einschätzung ihrer Eltern zu erfahren.
Bitte lesen Sie jede der folgenden Aussagen gründlich durch und geben Sie an, wie stark diese Behauptung auf Ihr Kind zutrifft. Manchmal kann es vorkommen, dass Sie sich nicht sicher sind, ob eine Aussage zustimmt oder nicht. In einem solchen Fall versuchen Sie sich bitte an Situationen zu erinnern, in denen Ihr Kind ein solches Verhalten gezeigt haben könnte und entscheiden Sie dann, wie sicher Sie sind, dass die Aussage zutrifft oder nicht. Es gibt keine falschen oder richtigen Antworten. Stützen Sie ihr Urteil auf Ihr gesamtes Wissen über Ihr Kind und Ihre gemeinsamen Erlebnisse und antworten Sie bitte ehrlich und nach reiflicher Überlegung. Um Ihre Einschätzung anzugeben platzieren Sie bitte einen vertikalen Strich an der entsprechenden Stelle auf der Antwortskala, die sich unter jeder Aussage befindet.

Wenn Sie unsicher sind, ob eine Aussage zutrifft oder nicht, setzen Sie ihre Markierung bitte unter „weiß ich nicht“. Sie können hier auch eine kleine Zustimmungs- oder Ablehnungstendenz angeben, indem Sie ihren Markierungs-Strich eher in die eine oder die andere Richtung der Skala verschieben.

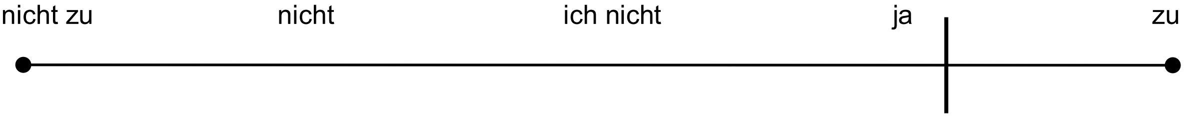
Zum Beispiel:

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu



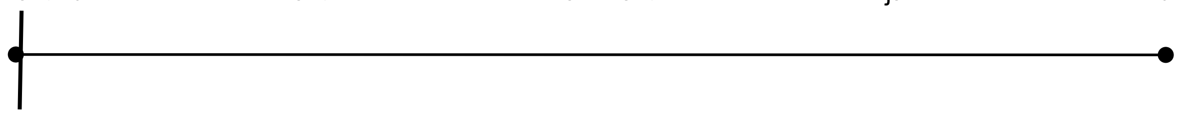
Wenn Sie meinen, dass eine der Aussagen tendenziell mehr oder weniger zutrifft, markieren Sie bitte die Skala an der Stelle, die am Besten zutrifft. Zum Beispiel:

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu



Wenn Sie sich absolut sicher sind, dass eine Aussage zutrifft oder nicht zutrifft, machen Sie bitte Ihren Markierungs-Strich auf dem Punkt rechts bzw. links von der Skala. Zum Beispiel:

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu



1. Wenn sich jemand eine Jacke anzieht, versteht mein Kind, dass dieser Person wohl kalt ist.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

2. Wenn ich an einem regnerischen Tag mit sarkastischer Stimme sage: „Na, das ist doch mal ein schöner Tag“, dann würde mein Kind begreifen, dass ich das nicht wortwörtlich meine.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

3. Mein Kind erkennt, wenn jemand in Not ist und Hilfe braucht.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

4. Mein Kind versteht, dass wenn jemand Angst im Dunkeln hat, er nicht gerne in dunkle Räume geht.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

5. Mein Kind kennt die Bedeutung von dem Verb ‘wollen’.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

6. Mein Kind weiß, dass man sich über die Wünsche anderer Menschen irren kann.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

7. Mein Kind begreift, dass Menschen mit einem finsteren Gesichtsausdruck sich anders fühlen als Menschen mit einem Lächeln im Gesicht.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

8. Mein Kind kennt die Bedeutung von dem Verb ‘denken’.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

9. Mein Kind weiß, dass Menschen eher glücklich sind wenn sie bekommen was sie wollen.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

10. Ich lasse meinen Schlüssel auf dem Tisch liegen und verlasse den Raum. Wenn mein Kind nun den Schlüssel vom Tisch nimmt und in eine Schublade legt, wird es nachvollziehen können, dass ich erst an der Stelle nach dem Schlüssel suche, an der ich ihn zuletzt gesehen habe.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

11. Mein Kind begreift, dass sich ein Mensch nicht von einem Tag auf den anderen ändert (bezogen auf sein Verhalten und seine Persönlichkeit).

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

12. Mein Kind kann nachvollziehen, dass man den wahren Inhalt einer Schachtel nur kennen kann, wenn man diesen gesehen hat oder es gesagt bekommt.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

13. Mein Kind kennt die Bedeutung von dem Verb ‘wissen’.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

14. Der Schein kann trügen. Zum Beispiel würden die meisten Menschen eine Kerze, die aussieht wie ein Apfel, zuerst für einen Apfel halten. Wenn sie genauer hinschauen stellen sie fest, dass das Objekt in Wirklichkeit doch eine Kerze ist und ändern ihre vorherige Meinung. Mein Kind würde in dieser Situation verstehen, dass nicht das Objekt selbst sich verändert hat sondern nur die Meinung über das Objekt.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

15. Wenn ich meinem Kind eine Müsli Schachtel zeige, die mit Keksen gefüllt ist und es dann frage: "Was würde jemand denken, was in dieser Schachtel ist, wenn er nicht reingeschaut hätte?", würde mein Kind antworten, dass die andere Person Müsli in der Schachtel erwarten würde.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

16. Wenn ich sage „Jetzt hauen wir uns mal auf's Ohr!" weiß mein Kind, dass ich eigentlich meine „Lass uns schlafen gehen!".

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

17. Mein Kind weiß, dass manche Menschen bewusst lügen um andere in die Falle zu locken oder in die Irre zu führen.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

18. Wenn jemand eine Vermutung äußert, begreift mein Kind, dass diese Aussage weniger zuverlässig ist als wenn jemand etwas wirklich weiß.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

19. Mein Kind begreift, dass wenn man an einen Keks denkt, man diesen Keks nicht wirklich riechen, essen oder teilen kann.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

20. Mein Kind weiß, dass man lächeln kann ohne glücklich zu sein.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

21. Mein Kind versteht den Unterschied zwischen den Neckerein eines Freundes und den Hänseleien eines bösen Kindes.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

22. Mein Kind begreift, dass man manchmal nicht sagt was man denkt um die Gefühle anderer Menschen nicht zu verletzen.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

23. Mein Kind kennt den Unterschied zwischen Lüge und Spaß.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

24. Wenn zwei Menschen ein Objekt von zwei unterschiedlichen Seiten betrachten, kann mein Kind nachvollziehen, dass sie das Objekt verschieden wahrnehmen.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

25. Mein Kind kennt die Bedeutung von dem Verb „brauchen“.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

26. Mein Kind weiß, dass man oft über die Gedanken anderer Menschen nachdenkt.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

27. Mein Kind weiß, dass man oft über die Gefühle anderer Menschen nachdenkt.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

28. Mein Kind kann unterscheiden, ob man jemanden absichtlich oder aus Versehen verletzt hat.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

29. Mein Kind kennt die Bedeutung von dem Verb „wünschen".

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

30. Mein Kind erkennt wenn andere glücklich oder fröhlich sind.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

31. Mein Kind kann so tun als ob ein Spielzeug etwas ganz anderes ist (zum Beispiel, so tun als ob eine Banane ein Telefon wäre).

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

32. Mein Kind bemerkt es, wenn man nicht richtig zuhört.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

33. Wenn ich ängstlich bin, weiß mein Kind, dass die Situation unsicher oder gefährlich ist.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

34. Mein Kind versteht das Wort "wenn/falls", wenn es hypothetisch genutzt wird, zum Beispiel „Wenn ich das Geld hätte, würde ich mir ein großes Haus kaufen".

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

35. Wenn jemand mit seinen Händen einen Vogel nachmacht, weiß mein Kind, dass diese Person nicht wirklich denkt, dass dies ein Vogel sei.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

36. Mein Kind kann Geschichten erfinden um zu bekommen was es will.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

37. Mein Kind weiß, dass es beim Verstecken spielen darum geht, möglichst nicht gefunden zu werden.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

38. Mein Kind weiß, dass wenn man ein Versprechen gibt, man es auch halten sollte.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

39. Mein Kind kann sich in andere hinein versetzen und nachvollziehen wie sie sich fühlen.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

40. Mein Kind weiß, dass wenn man ein Geheimnis teilt, man dieses nicht weiter erzählen soll.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

41. Mein Kind weiß, dass Menschen unterschiedlich sind.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

42. Wenn ich sage „Was ist gelb-braun gestreift und macht ‘mus-mus’? Eine Biene, die rückwärts fliegt!“ versteht mein Kind, dass ich ein Wortspiel gemacht habe.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

43. Mein Kind zeigt mir Dinge.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

44. Mein Kind ist aufmerksam.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

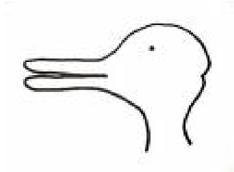
45. Mein Kind kennt die Bedeutung von dem Verb “glauben” (nicht im religiösen Sinne).

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

46. Wenn wir jemanden mögen, dann neigen wir dazu das Verhalten dieser Person positiv zu bewerten. Wenn wir aber jemanden nicht mögen, dann bewerten wir dessen Verhalten eher negativ. Mein Kind versteht, dass Vorurteile und vorgefasste Meinungen über andere unsere Wahrnehmung beeinflussen können.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

47. Mein Kind kann nachvollziehen, dass zwei Menschen das gleiche Bild ansehen können und es unterschiedlich interpretieren. Zum Beispiel sehen manche Menschen im folgenden Bild einen Hasen, während andere eine Ente sehen.



Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu

48. Wenn Moritz ein gemeiner Junge ist und Philip ein liebes Kind, weiß mein Kind, dass Moritz sich eher bösartig und heimtückisch verhalten wird als Philip.

Stimme nicht zu	Eher nicht	Weiß ich nicht	Eher ja	Stimme zu